Kinder Morgan Linnton Terminal

Phase 2 Bank Soils Investigation Results

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DATE: March 28, 2012

Introduction

This technical memorandum (TM) presents the results of the second phase investigation of subsurface bank soils along the shoreline of Kinder Morgan's Linnton Terminal (the Site) (Figure 1). A letter work plan for this investigation was submitted to ODEQ on October 3, 2011. ODEQ provided comments to the work plan on October 12, 2011. The work plan was resubmitted on October 13, 2011 with ODEQ comments incorporated. This investigation was also performed following methods outlined in the previously submitted *Banks Soils Work Plan (*CH2M HILL, 2010a) and *Bank Soils Work Plan Addendum* (CH2M HILL, 2010b).

Previous bank soils investigations at the Site have included assessment and characterization of erodible soils and characterization of subsurface bank soils. The erodible soils assessment and characterization of erodible soils has been completed and submitted to ODEQ under separate cover (CH2MHILL, 2010c). The first phase of the subsurface bank soil characterization was completed in November 2010, and a technical memorandum was submitted to ODEQ on March 28, 2011 *(Subsurface Bank Soils Investigation Results).*

The purpose of the investigation was to assess the potential for subsurface bank soils to act as a source of contamination to the Willamette River. The work completed is aligned with the overall goals of the Portland Harbor Joint Source Control Strategy (JSCS) which are to screen, identify, and evaluate (and, if necessary, control or eliminate) areas that may be potential sources re-contaminating the Willamette River after sediment cleanup work has been completed. For the purposes of this TM, bank soils are defined as soils located on the embankment that extends from the top of slope to the bottom of slope adjacent to the Willamette River. For bank soils, the following two potential migration pathways could allow contaminants to reach the river:

- Erosion of contaminated bank soils into the Willamette River
- Leaching of contaminants from bank soils and migration of these contaminants to the river via groundwater/surface water pathways

The following three primary tasks were proposed in the work plans to evaluate the bank soils:

- Erodible Soils Assessment
- Characterization of Erodible Soils
- Characterization of Subsurface Bank Soils

The erodible soils assessment has been completed and submitted to ODEQ under separate cover (CH2M HILL, 2010c). The erodability assessment provides a detailed description of current bank conditions and geometry, identifies bank erosion mechanisms and areas where the bank may be susceptible to erosion.

Constituents of Potential Concern

Previous soil investigations (Delta, 2009; KHM 2003; KHM 2002) have narrowed the constituents of potential concern (COPC) to the following:

- Total petroleum hydrocarbons (TPH) as gasoline, diesel, and lubrication oil ranges
- Aromatic volatile organic compounds (VOC), including benzene, toluene, ethylbenzene, xylenes, and naphthalene (BTEX-N)
- Polycyclic aromatic hydrocarbons (PAH)
- Metals

Subsurface Bank Soils Sampling Methods

Work described in this section involves collecting soil samples from the subsurface, analyzing these samples for the COPCs, and comparing them against screening levels.

Sampling Design

Subsurface soil borings collected during the first phase of the bank soils assessment were located within the bank stabilizing rip-rap, nearer to the bulkhead. The large-diameter (from 4-inches to greater than several feet in diameter) rip-rap armoring the bank made it difficult to reach target depths using hand-auger boring techniques. The second phase of subsurface soil sampling was generally conducted riverward of the first phase sampling when river levels were at a seasonal low and mostly unarmored bank soils were exposed.

Prior to both phases of subsurface soil sampling, CH2MHILL and Delta Environmental/Antea Group evaluated the use of angle borings to reach the target depths under the bulkhead and rip-rap. Several factors made this approach infeasible. In the area adjacent to the lower tank farm (southeast portion of site), a drill rig could not be oriented perpendicular to the wall for angle drilling into the bank soils due to limited space in this area. Angle drilling would also require boring through the retaining wall and beneath utilities located along the top of slope in order to reach the target depths. Such drilling would be challenging, potentially risky, and have a high likelihood of encountering large rip rap that would prevent successful collection of soil samples at the target depths. Because of these challenges presented by angle boring, hand-auger soil borings were chosen as the preferred method of sample collection.

A total of 12 hand-auger soil borings (BA-7 through BA-18) were collected during the second phase in October 2011. The locations of the second phase soil borings are shown in Figure 2. These locations were based on the locations of historical releases and were selected to assess the potential for subsurface bank soils to act as a source of contamination to the Willamette River in four areas (from downstream to upstream):

- **Area 1 (Figure 3)** - Samples BA-8 and BA-9 were collected to the east and sample BA-7 to the north of previous location BA-5, to assess subsurface soil contamination potentially sourced from BA-5.
- **Area 2 (Figure 4)** - Samples BA-10 and BA-11 were collected to the east of previous location BA-1, to assess subsurface soil contamination potentially sourced from BA-1.
- **Area 3 (Figure 5)** - Sample BA-12 was collected to the east and sample BA-13 to the north of previous location BA-2, to assess subsurface soil contamination potentially sourced from BA-2.
- **Area 4 (Figure 6)** - Samples BA-16 and BA-18 were collected to the south, BA-15 to the east, and BA-14 to the north of previous location BA-4, to assess subsurface soil contamination potentially sourced from the sheen area near BA-4.

With the exception of BA-17, where boring refusal prevented any soil sample from being collected, data from these borings were added to existing bank soils data for subsurface evaluation. Existing site data include the 17 hand-auger soil borings from Phase 1 in November 2010 (CH2M HILL, 2010ab) and borings CH-1 and CH-2 installed during the LNAPL assessment (CH2MHILL, 2010d).

Sampling Procedure

The field team collected continuous soil at each sample location using a hand auger. Because sample locations were not accessible by limited access drill rig and the elevation of the target depths were reachable by hand auger, subsurface soil sample collection was completed using hand auger techniques. Soil boring locations were measured using a resource-grade global positioning unit (GPS) accurate to less than 1 meter with post-processing correction. Sample locations were logged by field personnel using the Unified Soil Classification System and screened using a field portable photo-ionization detector and visual/olfactory observations of hydrocarbons. For oil impacted sections of the soil core, the following conventions were used in the soil descriptions:

- None Visible – Visible NAPL is not observed in the soil core interval
- Odor – Petroleum odor or positive response to an organic vapor detector
- NAPL Sheen – NAPL is not visible but a distinct film is evident
- NAPL-Impregnated – NAPL is visible in the spaces between the soil grains but NAPL does not flow from the sample
- Free NAPL – Soil is NAPL-impregnated and NAPL flows from the soil grains to the surface of the sample

Target depths of the subsurface bank soils were correlated to the elevation of the areas of LNAPL impacts identified in the CPT/LIF and other boring and well log data that was previously collected behind the wall. Target depths were sampled for non-volatile analytes by removing discrete intervals from the soil sampling tools and packing these interval samples into glass soil jars. For volatile analytes, soil was placed into soil jars and low-level VOC sampling containers. A total of 36 subsurface bank soil samples were collected for analytical testing.

Sample Analysis

Samples were preserved to 4°C, handled using chain-of-custody protocols, and delivered to the environmental testing laboratory within holding times. Soil samples were submitted to Alpha Analytical Laboratory in Sparks, Nevada, for the following analyses:

- TPH – Northwest total petroleum hydrocarbon Method NWTPH
- Polycyclic aromatic hydrocarbons (PAHs) per Method 8270M-SIM
- Volatile organic compounds (VOCs) per Method 8260B
- Metals - arsenic, barium, cadmium, copper, chromium, mercury, lead, selenium, and zinc per Method 7471 for mercury and Method 6020 (6000/7000 Series) for all other metals.

Select soil samples were also submitted to the Battelle laboratory for analysis of polycyclic aromatic hydrocarbons (PAHs) per Method 8270M-SIM.

Subsurface Bank Soils Analysis Results

Results of analyses of the 36 subsurface bank soils collected during this investigation are presented by COPC class in Tables 1-3. The sample name in these tables refers to the sample location (e.g., BA-1) and then the depth (e.g., 8 feet) at which the sample was collected (e.g., BA-1-8). A “U” flag adjacent to a value indicates that this CPOC was not detected above the method reporting limit (MRL); in these cases, the value shown is the MRL. Detected values were compared to the most recent (July 2007) screening level values (SLVs) for toxicity and bioaccumulation for the Portland Harbor Joint Source Control Strategy (ODEQ, 2005: Table 3-1).

Soils encountered in hand auger borings as part of the Subsurface Bank Soils investigation generally consisted of layers of sands and silts with trace subsurface gravel, which are consistent with soils encountered along the Willamette River. These soils ranged from silty to poorly graded sand at the surface to interbedded layers of silty sand and silt at depths to 2 to 4 feet below ground surface (bgs). Cobbles and boulders observed near the surface of some of the boring locations is riprap or bank armor. Some wood fragments and other organic material were observed within the silt layers, which supports low energy depositional environments observed along the river, which is typical for most sites along this reach of the river. The silt layers observed in some borings are discontinuous across the riverfront. NAPL impacts are noted on the boring logs; boring logs are included in Appendix A.

Polycyclic Aromatic Hydrocarbons (PAHs) (Table 1)

PAHs were detected in 22 of 36 locations during the second phase. During the first phase, one or more PAHs exceed their SLV in 8 locations, with the maximum concentration (71,600 μg/kg) at BA-5C-3.5 for pyrene. During the second phase, SLVs were exceeded in only 6 locations, with the maximum concentration (7,600 μg/kg) at BA-10-1 for pyrene. In general, the PAH detections in the subsurface bank soils corresponded to the CPT/LIF data from the LNAPL investigation.

Total Petroleum Hydrocarbons and VOCs (Table 2)

Total petroleum hydrocarbons (TPH) were detected above their MRLs in 15 of 36 soil samples, at concentrations ranging from 5.5 milligrams per kilogram (mg/kg) as gasoline (TPH-G) at BA-9-3 to 12,000 mg/kg as diesel (TPH-D) at BA-14-2 (Table 3).

Two VOCs (benzene and toluene) were detected in two locations (BA-7-4, BA-8-3.5). The benzene concentration at BA-8-3.5 (72 mg/kg) was the highest detected VOC concentration in soil. Ethylbenzene and xylene were not detected above the MRL in any soil sample.

There are currently no SLVs for diesel-, gasoline-, or oil-range TPHs or for any VOCs. However, for comparison purposes only, sediment toxicity (not bioaccumulation) values were obtained from U.S. EPA and Massachusetts DEP documents (MDEP, 2007; USEPA, 2006). The comparison value for benzene (57 mg/kg @ 1% organic carbon (OC)) was exceed in only one sample (BA-8-3.5); those for toluene (890 mg/kg @ 1% OC), ethylbenzene (4,800 mg/kg @ 1% OC), and total xylenes (25 mg/kg @ 1% OC)were not exceeded. Comparison values for diesel-TPH (3,200 mg/kg @ 1% OC) were equaled or exceeded in three second phase samples (BA-12-2.5, BA-14-0, BA-14-2); those for oil-TPH (9,800 mg/kg @ 1% OC)) and gasoline-TPH (1,500 mg/kg @ 1% OC)) were not exceeded in any second phase sample.

Metals (Table 3)

Arsenic, cadmium, and zinc were the only metals detected in at least one soil sample. Arsenic exceeded its SLV for bioaccumulation (7.0 mg/kg) in nine sample locations (BA-1-8, BA-1-9.5, BA-2-6.5, BA-5-4.5, BA-5C-3.5, BA-7-4, BA-8-3.5, BA-14-0, BA-15-0). Cadmium exceeded its SLVs for both toxicity (4.98 mg/kg) and bioaccumulation (1 mg/kg) at one location (BA-8-3.5). Lead exceeded its bioaccumulation SLV (17.0 mg/kg) at nine locations, with the highest concentration found at BA-5C-3.5 (119 mg/kg) during the first phase and at BA-8-3.5 (49 mg/kg) during the second phase. Mercury and selenium were not detected in any samples. All detections of chromium and zinc were below their respective SLVs. Barium was detected in all samples, but there is no SLV for this metal.

Conclusions and Recommendations

Conclusions

The purpose of this investigation was to characterize the potential for subsurface bank soils to act as a source of contamination to the Willamette River. “A source of contamination” was interpreted to mean erodible subsurface bank soils containing COPCs in excess of Joint Source Control Strategy SLVs. The contamination potential of soils in different locations was assessed based on the number of detections above SLVs (or comparison value for TPHs and BTEX VOCs) for each COPC class (i.e., PAHs, TPHs, VOC, Metals) at all sample depths. This was done at four locations in the vicinity of samples taken during the first phase:

- **Area 1** - Samples BA-7, -8 and -9 were taken to assess the presence of potential source soils in the vicinity of BA-5. As shown in Figure 3, the presence of PAHs above SLVs at BA-8 suggests that soils in this area, if they were erodible to 3.5 feet bgs, could be a source of COPCs to the river. The same could be said for soils at BA-7 and BA-9, provided that erodability in these locations extended to 4 feet bgs. The vertical extent of COPCs is bounded at 9.0 feet bgs in BA-8, at 4.0 feet bgs in BA-9, but is not known at BA-7. The upper bulkhead is present and continuous along this section of the Site and the riprap armoring along the upper portion of the slope has remained in place over most of the bank. There are only small and isolated areas where some of the larger riprap appears to be missing from the upper sections of the bank between elevations 26 and 30 feet

(CH2MHILL, 2010c). Therefore the potential for erosion of riverbank material is very low and subsurface soils are very unlikely to serve as a source of contaminants in this area.

- **Area 2** - Samples BA-10 and BA-11 were taken to assess the presence of potential source soils in the vicinity of BA-1. As shown in Figure 4, the presence of PAHs above SLVs at BA-10 suggests that soils in this area, if they were erodible to 1 foot bgs, could be a source of COPCs to the river. The same could be said for soils at BA-11, provided that erodability there extended to 2.5 feet bgs. The vertical extent of COPCs can be bounded at 4.5 feet bgs in BA-10 and at 4.5 feet bgs in BA-11. This area is covered between existing bulkheads with riprap armoring ranging in size from over 2 feet diameter down to large gravel and cobbles having dimensions of 3 to 4 inches diameter (CH2MHILL, 2010c). Therefore the potential for erosion of riverbank material is very low and subsurface soils are very unlikely to serve as a source of contaminants in this area.
- **Area 3** - Samples BA-12 and BA-13 were taken to assess the presence of potential source soils in the vicinity of BA-2. As shown in Figure 5, the presence of PAHs above SLVs at BA-12 suggests that soils in this area, if they were erodible to 2.5 feet bgs, could be a source of COPCs to the river. The same could be said for soils at BA-13, provided that erodability in this location extended to 3.5 feet bgs. The vertical extent of COPCs is bounded at 7.0 feet bgs in BA-12 and at 7.5 feet bgs in BA-13. This area is covered between existing bulkheads with riprap armoring ranging in size from over 2 feet diameter down to large gravel and cobbles having dimensions of 3 to 4 inches diameter (CH2MHILL, 2010c). Therefore the potential for erosion of riverbank material is very low and subsurface soils are very unlikely to serve as a source of contaminants in this area.
- **Area 4** - Samples BA-14 and B-15 were taken to assess the presence of potential source soils in the vicinity of BA-4, which is in the area of where sheening events occur. Borings BA-16, BA-17, and -18 were installed to assess conditions south of the known sheening area. Samples could not be collected at BA-17 as planned because subsurface cobbles and rip-rap throughout the area caused refusal of the hand auger. As shown in Figure 6, there are no petroleum-related COPC concentrations in soils greater than their SLVs river-ward or upstream of the BA-4 seep area. The presence of PAHs and TPHs above SLVs at BA-14 at ≤ 2 feet bgs suggests that (a) this location, if erodible, could be a source of COPCs to the river and (b) the seep area may extend laterally to the north. . The vertical extent of COPCs at BA-14 is bounded at 7.5 feet bgs. However, as this is the most heavily armored section of riverbank at the Site (CH2MHILL, 2010c), the potential for erosion of riverbank material is very low and subsurface soils are very unlikely to serve as a source of contaminants in this area.

In order for subsurface soils with COPC concentrations in excess of SLVs to reach the river, erosion would have to extend to a depth ≥ 2 feet bgs. In most areas, riprap armoring stone covers the riverbank and has sufficient size and depth to prevent erosion from river currents. In areas where the armoring stone is not present at the surface, minor erosion could occur during large flood events with recurrence intervals of greater than 50 years. Even during these flood events, as finer material was removed by erosion, coarser gravels present would begin to naturally armor the surface and minimize the depth of erosion. For this reason, it is expected that the potential erosion depth due to river currents along the riverbank would be low, even during a large flood. A reasonable assumption of the maximum depth of erosion due to river currents would be about 1 foot. As no subsurface contamination is this close to the surface, the potential for subsurface soils to serve as a source of contaminants to the river is unlikely.

Recommendations

Overall, results from this investigation, in conjunction with those from previous soils investigations, show that subsurface bank soils in selected locations have little potential to serve as a source of contamination to the Willamette River for the reasonably foreseeable future. Any future realization of this potential is governed by the erodability of soils in these locations, which is very low due to the presence of rip rap and bulkheads. CH2M HILL therefore recommends that Kinder Morgan and ODEQ schedule a consultation meeting to reach agreement on the low potential for subsurface soils to act as a source of COPCs to the Willamette River.

References

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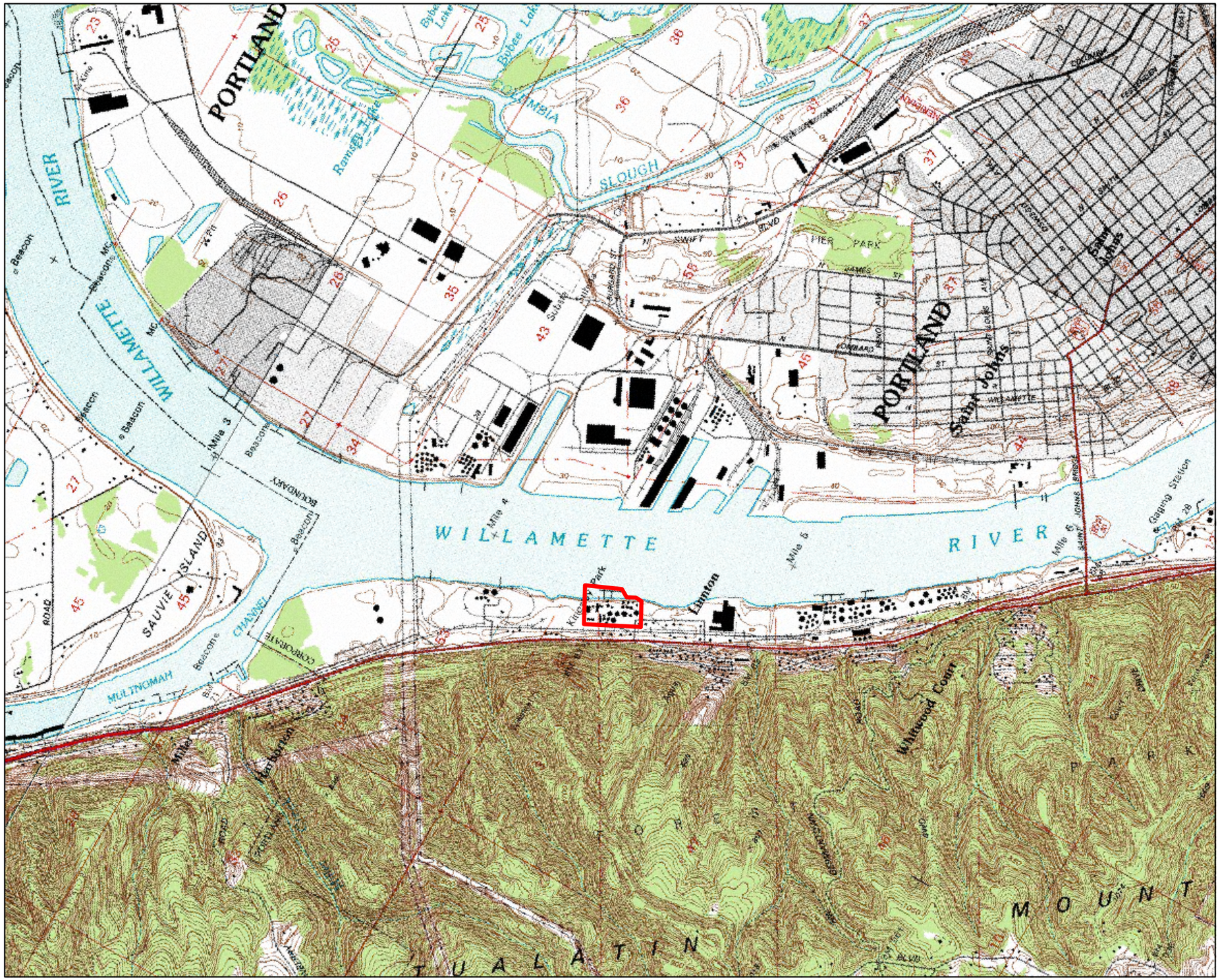
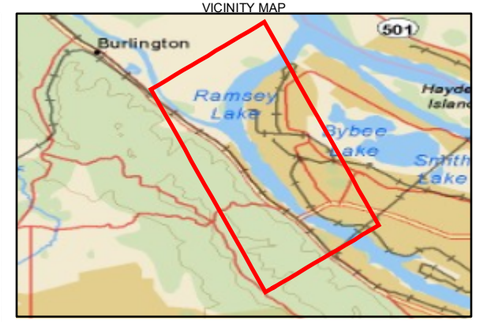


VICINITY MAP



LEGEND

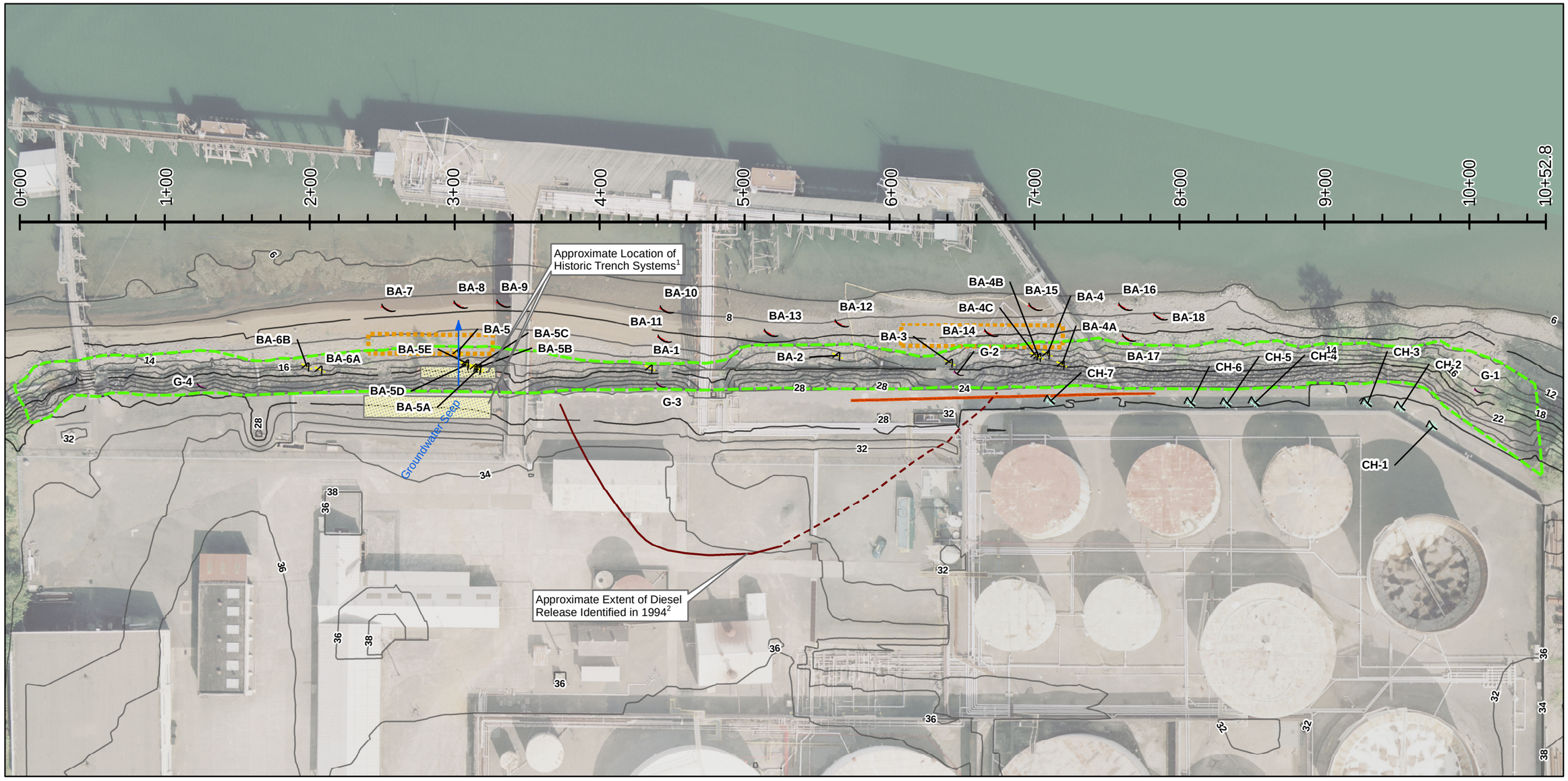
Site Boundary

N

0 1,700 3,400

Feet

FIGURE 1
Site Location Map
Kinder Morgan
Multnomah County, OR



VICINITY MAP

LEGEND

- Minor Contour Line
- Major Contour Line
- Proposed 215-foot barrier wall
- Extent of Bank Soil
- Historic Trench System
- Approximate Area Where Sheen was Observed

Bank Soils

- Bank Soils Boring
- Surface Sample
- Bank Soils Boring

References:

1. Based on details presented in letter from Harry DeMaray of GATX to DEQ dated August 4, 1992.
2. Based on results of direct-push investigation presented in Subsurface Environmental Site Assessment Reoprt (AGRA, 1996)

0 25 50 100
Feet

FIGURE 2
Subsurface Sampling Locations

Kinder Morgan Liquid Terminals LLC
Linnton Terminal
11400 NW St. Helens Road
Portland, Oregon

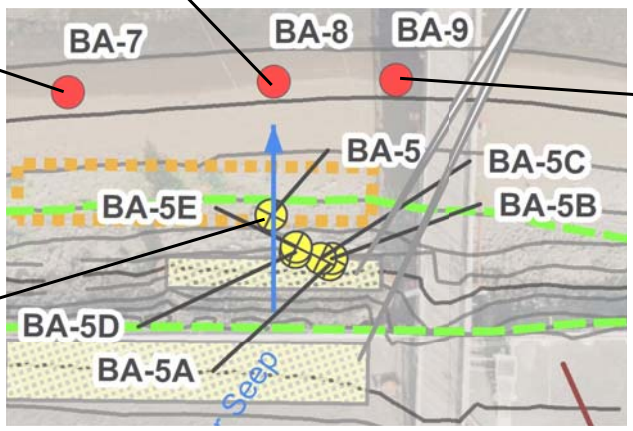
CH2MHILL

BA-7	
COPC	**Exceeded**
PAH	2
TPH	0
VOC	0
Metals	2

BA-8	
COPC	**Exceeded**
PAH	6
TPH	0
VOC	1
Metals	3

BA-9	
COPC	**Exceeded**
PAH	1
TPH	0
VOC	0
Metals	1

BA-5	
COPC	**Exceeded**
PAH	21
TPH	4
VOC	0
Metals	3

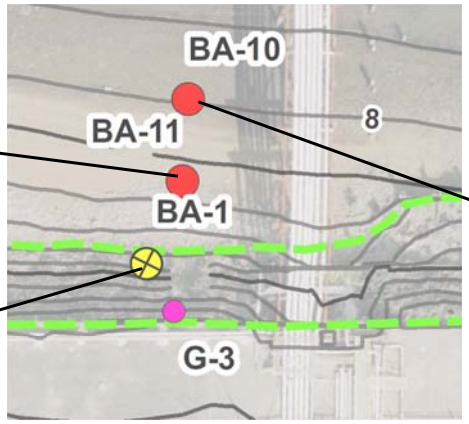


Exceeded = Number of times SLV was exceeded.

FIGURE 3
Number of detections above SLVs by COPC at all depths near BA-5
Kinder Morgan Liquids Terminals LLC
Linnton Terminal
11400 NW St. Helens Road
Portland, Oregon

BA-11	
COPC	**Exceeded**
PAH	3
TPH	0
VOC	0
Metals	3

BA-1	
COPC	**Exceeded**
PAH	9
TPH	0
VOC	0
Metals	2



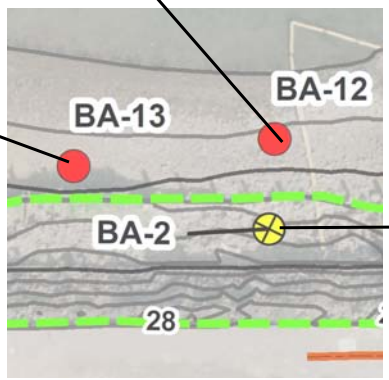
BA-10	
COPC	**Exceeded**
PAH	8
TPH	0
VOC	0
Metals	2

Exceeded = Number of times SLV was exceeded.

FIGURE 4
Number of detections above SLVs by COPC at all depths near BA-1
Kinder Morgan Liquids Terminals LLC
Linnton Terminal
11400 NW St. Helens Road
Portland, Oregon

BA-12	
COPC	**Exceeded**
PAH	4
TPH	1
VOC	0
Metals	0

BA-13	
COPC	**Exceeded**
PAH	12
TPH	0
VOC	0
Metals	1



BA-2	
COPC	**Exceeded**
PAH	9
TPH	1
VOC	0
Metals	2

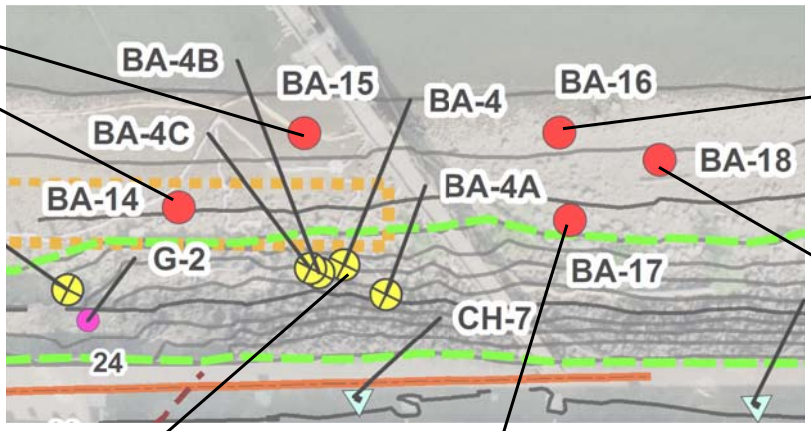
Exceeded = Number of times SLV was exceeded.

FIGURE 5
Number of detections above SLVs by COPC at all depths near BA-2
Kinder Morgan Liquids Terminals LLC
Linnton Terminal
11400 NW St. Helens Road
Portland, Oregon

BA-15	
COPC	**Exceeded**
PAH	0
TPH	0
VOC	0
Metals	2

BA-14	
COPC	**Exceeded**
PAH	5
TPH	2
VOC	0
Metals	2

BA-4	
COPC	**Exceeded**
PAH	11
TPH	2
VOC	0
Metals	0



BA-16	
COPC	**Exceeded**
PAH	0
TPH	0
VOC	0
Metals	0

BA-18	
COPC	**Exceeded**
PAH	0
TPH	0
VOC	0
Metals	1

Exceeded = Number of times SLV was exceeded.

FIGURE 6
Number of detections above SLVs by COPC at all depths near BA-4
Kinder Morgan Liquids Terminals LLC
Linnton Terminal
11400 NW St. Helens Road
Portland, Oregon

Table 1
Analytes Detected in Soil, PAH
Kinder Morgan - Linnton Terminal,
Portland, Oregon

			PAH - SW8270C (ug/kg)																	
Sample Name	**Sample Date**	**Sample Depth (feet bgs)**	**2-Methyl-naphthalene**	**Acenaphthene**	**Acenaphthylene**	**Anthracene**	**Benzo (a) anthracene**	**Benzo (a) pyrene**	**Benzo(b&k) fluoranthene, isomeric pair**	**Benzo (g,h,i) perylene**	**Chrysene**	**Dibenz (a,h) anthracene**	**Fluoranthene**	**Fluorene**	**Indeno (1,2,3-cd) pyrene**	**Naphthalene**	**Phenanthrene**	**Pyrene**
MacDonald PECs and other SQVs			*200*	*300*	*200*	*845*	*1,050*	*1,450*	*13,000*	*300*	*1,290*	*1,300*	*2,230*	*536*	*100*	*561*	*1,170*	*1,520*
DEQ 2007 Bioaccumulative Sediment SLVs			--	--	--	--	--	--	--	--	--	--	*37,000*	--	--	--	--	*1,900*
BA-1-8	11-Nov-10	8	16.8 U	59.6	19.6	34.6	59.8	89.7	190	110	102	23.8	127	30.5	92.7	16.8 U	54.1	125
BA-1-9.5	10-Nov-10	9.5	172 U	**2,950**	172 U	**996**	**2,230**	650	1,408	274	**1,480**	172 U	**8,930**	**2,110**	**246**	172 U	**4,510**	**8,080**
BA-1-11.5	11-Nov-10	11.5	18.1 U	21.9	18.1 U	18.1 U	18.1 U	18.1 U	18.1 U	18.1 U	18.1 U	18.1 U	45.9	18.1 U	18.1 U	18.1 U	25.3	38.1
BA-2-4.5	11-Nov-10	4.5	19.5 U	144	29.3 U	81.6	72.6	97.1	130	105	89.8	19.5 U	255	233	65.5	39 U	534	366
BA-2-6.5	11-Nov-10	6.5	192 U	**11,000**	**575 U**	**5,810**	**3,140**	1,060	2,270	273	**3,110**	192 U	**22,600**	**16,400**	**264**	383 U	**60,300**	**14,900**
BA-3-4.5	9-Nov-10	4.5	20 U	23.6	20 U	24.5	41.8	88.0	110	104	58.8	20 U	78.6	28.6	66.4	20 U	47.5	211
BA-3-8	9-Nov-10	8	21.5 U	58.0	21.5 U	32.2 U	21.5 U	21.5 U	21.5 U	21.5 U	43.4	21.5 U	49.5	53.6 U	21.5 U	21.5 U	131	90.7
BA-4-5	12-Nov-10	5	**3,960 U**	**16,900**	**5,930 U**	**7,400**	1,020	953	791 U	791 U	**1,820**	791 U	**3,190**	**41,700**	**791 U**	**5,930 U**	**61,700**	**6,590**
BA-5-4.5	12-Nov-10	4.5	177 U	**1,960**	**532 U**	**857**	254	279	229	246	418	177 U	752	**2,860**	**177 U**	532 U	**7,000**	1,330
BA-5C-3.5	12-Nov-10	3.5	**54,200**	**8,860**	**1,930 U**	**14,400**	**14,500**	**15,100**	6,990	**9,030**	**21,600**	**1,930 U**	**8,070**	**10,200**	**3,360**	**1,930 U**	**53,100**	**71,600**
CH-1	7-Sep-10	20	25 U	2,300	25 U	580	740	420	1,460	200	400	25 U	1,400	3,500	190	1,200	3,600	2,000
CH-2	8-Sep-10	20	25 U	5,700	25 U	440	1,100	620	2,400	360	540	54	2,300	1,700	320	240	1,900	2,900
CH-3	7-Sep-10	19	25 U	2,900	25 U	520	170	58	300	51	110	25 U	410	5,100	43	1,300	4,600	570
BA-7-0	26-Oct-11	0	--	25 U	25 U	25 U	25 U	25 U	50 U	34	27	25 U	35	25 U	29	25 U	25 U	36
BA-7-4	26-Oct-11	4	--	140	25 U	37	270	370	460	**390**	420	58	1,200	57	**300**	60	470	1,500
BA-8-0	26-Oct-11	0	--	25 U	25 U	25 U	25 U	25 U	57	25 U	36	25 U	47	25 U	25 U	25 U	25 U	53
BA-8-3.5	26-Oct-11	3.5	--	**1,500**	**250**	230	230	300	390	250	430	42	1,600	**1,300**	**220**	280	**2,100**	**2,000**
BA-9-0	26-Oct-11	0	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-9-3	26-Oct-11	3	--	230	40	94	280	300	420	250	380	56	740	53	**240**	26	770	980
BA-9-4	26-Oct-11	4	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-9-8.5	26-Oct-11	8.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-10-0	26-Oct-11	0	--	25 U	25 U	25 U	25 U	39	110	47	95	25 U	170	25 U	46	25 U	84	130
BA-10-1	26-Oct-11	1	--	**2,500**	100	210	**1,500**	**2,100**	2,200	**2,100**	**1,800**	320	**5,500**	260	**1,500**	300	620	**7,600**
BA-10-4.5	26-Oct-11	4.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-10-7.5	26-Oct-11	7.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-11-0	26-Oct-11	0	--	25 U	25 U	25 U	25 U	25 U	50 U	28	25 U	25 U	25 U	25 U	35	25 U	25 U	25 U
BA-11-2.5	26-Oct-11	2.5	--	240	25	130	550	1,100	1,700	**1,500**	1,000	200	1,800	57	**1,100**	89	460	**2,500**
BA-11-4.5	26-Oct-11	4.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-11-8.5	26-Oct-11	8.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-12-0	25-Oct-11	0	--	25 U	25 U	25 U	55	90	130	130	140	36	67	25 U	89	25 U	25 U	110
BA-12-2.5	25-Oct-11	2.5	--	**340**	50	140	810	620	690	**510**	1,100	170	1,000	31	**470**	130	590	**1,800**
BA-12-7	25-Oct-11	7	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	30	25 U	25 U	26
BA-13-0	26-Oct-11	0	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-13-3.5	26-Oct-11	3.5	--	**2,000**	**430**	**940**	**1,200**	850	2,100	**1,300**	**2,100**	330	**4,200**	**1,200**	**950**	**4,300**	**6,100**	**7,500**
BA-13-7.5	26-Oct-11	7.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-14-0	25-Oct-11	0	--	25 U	60 U	420	120	270	300	260	350	47	140	300	**200**	70	320	580
BA-14-2	25-Oct-11	2	--	**1,500**	**440**	670	140	91	110	63	230	25 U	400	**2,600**	61	**1,100**	**6,600**	580
BA-14-4	25-Oct-11	4	--	63	25 U	25 U	40	25 U	55	38	80	25 U	150	25 U	33	50	130	280
BA-14-7.5	25-Oct-11	7.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	32	25 U	38	25 U	25 U	25 U	25 U	93
BA-15-0	25-Oct-11	0	--	25 U	25 U	25 U	25 U	25 U	50 U	30	36	25 U	150	25 U	25 U	25 U	25 U	110
BA-15-1.5	25-Oct-11	1.5	--	25 U	25 U	25 U	41	55	91	89	77	25 U	120	25 U	68	25 U	50	160
BA-15-8	27-Oct-11	8	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-16-0.5	25-Oct-11	0.5	--	30	25 U	25 U	53	83	120	120	110	25 U	82	25 U	87	25 U	27	260
BA-16-4	25-Oct-11	4	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-16-7	25-Oct-11	7	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-18-0.5	27-Oct-11	0.5	--	25 U	25 U	25 U	25 U	32	50 J	53	38	25 U	48	25 U	47	25 U	25 U	82
BA-18-10	27-Oct-11	10	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
BA-18-2.5	27-Oct-11	2.5	--	25 U	25 U	25 U	41	100	160	150	94	25 U	57	25 U	**120**	25 U	28	160
BA-18-4.5	27-Oct-11	4.5	--	25 U	25 U	25 U	25 U	25 U	50 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U

Notes:

ug/kg = micrograms per kilogram

Screening Level Values (SLVs) taken from Table 3-1 of the Portland Harbor Joint Source Contro Strategy (JSCS) guidance document, updated July 16, 2007.

Bold = detected result exceeds screening level

Table 2
Analytes Detected in Soil, VOC and TPH
Kinder Morgan - Linnton Terminal,
Portland, Oregon

			VOC - SW8260B (ug/kg)												TPH (mg/kg)		
Sample Name	**Sample Date**	**Sample Depth (feet bgs)**	**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes (Total)**	**n-Butylbenzene**	**sec-Butylbenzene**	**Isopropylbenzene**	**p-Isopropyltoluene**	**n-Propylbenzene**	**1,1,2,2-Tetrachloroethane**	**1,2,4-Trimethylbenzene**	**1,3,5-Trimethylbenzene**	**TPH-E (DRO)**	**TPH-E (ORO)**	**TPH-P (GRO)**
MacDonald PECs and other SQVs			--	--											--	--	--
DEQ 2007 Bioaccumulative Sediment SLVs			--	--											--	--	--
BA-1-8	11-Nov-10	8	270 U	270 U	270 U	810 U	1,350 U	270 U	540 U	540 U	270 U	270 U	270 U	270 U	131	231	11.9 U
BA-1-9.5	10-Nov-10	9.5	297 U	297 U	297 U	891 U	1,480 U	297 U	594 U	594 U	297 U	297 U	297 U	297 U	243	274	13 U
BA-1-11.5	11-Nov-10	11.5	238 U	238 U	238 U	715 U	1,190 U	238 U	477 U	477 U	238 U	238 U	238 U	238 U	17 U	34 U	11 U
BA-2-4.5	11-Nov-10	4.5	321 U	321 U	321 U	963 U	1,610 U	321 U	642 U	642 U	321 U	321 U	321 U	321 U	297	139	45.8
BA-2-6.5	11-Nov-10	6.5	274 U	274 U	274 U	822 U	1,370	1,450	548 U	548 U	274 U	378	274 U	274 U	11,400	1,390	501
BA-3-4.5	9-Nov-10	4.5	263 U	263 U	263 U	789 U	1,310 U	263 U	526 U	526 U	263 U	263 U	263 U	263 U	118	92.1	54.0
BA-3-8	9-Nov-10	8	439 U	439 U	439 U	1,317 U	2,200 U	439 U	878 U	878 U	439 U	439 U	439 U	439 U	198	94.9	77.1
BA-4-5	12-Nov-10	5	3,290 U	3,290 U	3,290 U	9,880 U	40,400	41,200	38,500	6,590 U	42,100	7,120	3,290 U	3,290 U	96,300	7,560	11,800
BA-5-4.5	12-Nov-10	4.5	1,150 U	1,150 U	1,150 U	3,450 U	5,740 U	1,680	2,300 U	2,300 U	1,150 U	3,090	1,150 U	1,150 U	8,540	1,240	1,750
BA-5C-3.5	12-Nov-10	3.5	431 U	431 U	431 U	1,293 U	2,160 U	431 U	862 U	961	431 U	1,180	2,820	543	24,100	22,900	1,030
BA-7-0	26-Oct-11	0	6.7 U	6.7 U	6.7 U	6.7 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-7-4	26-Oct-11	4	6.3	9.3	6 U	6 U	--	--	--	--	--	20 U	--	--	690	810	7.1
BA-8-0	26-Oct-11	0	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-8-3.5	26-Oct-11	3.5	72	11	9 U	9 U	--	--	--	--	--	20 U	--	--	370	690	10
BA-9-0	26-Oct-11	0	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-9-3	26-Oct-11	3	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	2,000	2,800	5.5
BA-9-4	26-Oct-11	4	5.3 U	5.3 U	5.3 U	5.3 U	--	--	--	--	--	20 U	--	--	61	100 U	5 U
BA-9-8.5	26-Oct-11	8.5	5.9 U	5.9 U	5.9 U	5.9 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-10-0	26-Oct-11	0	6 U	6 U	6 U	6 U	--	--	--	--	--	20 U	--	--	49	220	5 U
BA-10-1	26-Oct-11	1	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	270	400	5 U
BA-10-4.5	26-Oct-11	4.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-10-7.5	26-Oct-11	7.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-11-0	26-Oct-11	0	5.4 U	5.4 U	5.4 U	5.4 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-11-2.5	26-Oct-11	2.5	7.4 U	7.4 U	7.4 U	7.4 U	--	--	--	--	--	20 U	--	--	400	770	5 U
BA-11-4.5	26-Oct-11	4.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-11-8.5	26-Oct-11	8.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-12-0	25-Oct-11	0	5.3 U	5.3 U	5.3 U	5.3 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-12-2.5	25-Oct-11	2.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	3,200	5,000	5 U
BA-12-7	25-Oct-11	7	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-13-0	26-Oct-11	0	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-13-3.5	26-Oct-11	3.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	1,400	1,900	5 U
BA-13-7.5	26-Oct-11	7.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-14-0	25-Oct-11	0	19 U	19 U	19 U	19 U	--	--	--	--	--	38 U	--	--	8,400	2,200	24
BA-14-2	25-Oct-11	2	270 U	270 U	270 U	270 U	--	--	--	--	--	550 U	--	--	12,000	1,500	310
BA-14-4	25-Oct-11	4	5.1 U	5.1 U	5.1 U	5.1 U	--	--	--	--	--	20 U	--	--	650	280	6.4
BA-14-7.5	25-Oct-11	7.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-15-0	25-Oct-11	0	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	50	150	5 U
BA-15-1.5	25-Oct-11	1.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	78	200	5 U
BA-15-8	27-Oct-11	8	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-16-0.5	25-Oct-11	0.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	88	100 U	5 U
BA-16-4	25-Oct-11	4	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-16-7	25-Oct-11	7	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-18-0.5	27-Oct-11	0.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	55	150	5 U
BA-18-10	27-Oct-11	10	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-18-2.5	27-Oct-11	2.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U
BA-18-4.5	27-Oct-11	4.5	5 U	5 U	5 U	5 U	--	--	--	--	--	20 U	--	--	25 U	100 U	5 U

Notes:

mg/kg = milligrams per kilogram

ug/kg = micrograms per kilogram

Screening Level Values (SLVs) taken from Table 3-1 of the Portland Harbor Joint Source Control Strategy (JSCS) guidance document, updated July 16, 2007.

Bold = detected result exceeds screening level.

Table 3
Analytes Detected in Soil, Metals
Kinder Morgan - Linnton Terminal,
Portland, Oregon

			METALS - SW6020/6020A (mg/kg)								
Sample Name	**Sample Date**	**Sample Depth (feet bgs)**	**Arsenic**	**Barium**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Selenium**	**Zinc**
MacDonald PECs and other SQVs			*33*	*--*	*4.98*	*111*	*149*	*128*	*1.06*	*5*	*459*
DEQ 2007 Bioaccumulative Sediment SLVs			*7*	*--*	*1*	*--*	*--*	*17*	*0.07*	*2*	*--*
BA-1-8	11-Nov-10	8	2.58	172	0.636 U	18.1	16.5	**29.2**	0.119 U	0.636 U	82.4
BA-1-9.5	10-Nov-10	9.5	6.16	170	0.643 U	33.3	36.0	**17.1**	0.0977 U	0.643 U	92.9
BA-1-11.5	11-Nov-10	11.5	5.45	185	0.685 U	32.4	20.2	15.4	0.117 U	0.685 U	74.7
BA-2-4.5	11-Nov-10	4.5	6.25	154	0.711 U	26.3	27.6	16.4	0.119 U	0.711 U	83.2
BA-2-6.5	11-Nov-10	6.5	**9.66**	145	0.693 U	24.1	24.5	**31.4**	0.0755 U	0.693 U	87.2
BA-3-4.5	9-Nov-10	4.5	**7.86**	151	0.753 U	27.4	26.3	16.4	0.08 U	0.753 U	81.8
BA-3-8	9-Nov-10	8	**9.75**	140	0.778 U	19.0	25.0	10.8	0.13 U	0.778 U	87.1
BA-4-5	12-Nov-10	5	5.40	125	0.596 U	21.3	18.7	10.3	0.113 U	0.596 U	55.6
BA-5-4.5	12-Nov-10	4.5	**7.50**	160	0.672 U	19.8	16.0	**38.3**	0.126 U	0.672 U	122
BA-5C-3.5	12-Nov-10	3.5	4.56	125	0.583 U	27.5	21.1	**119**	0.115 U	0.583 U	249
BA-7-0	26-Oct-11	0	**35**	86	1 U	13	21	15	0.2 U	1 U	66
BA-7-4	26-Oct-11	4	3.5	76	1 U	14	19	**21**	0.2 U	1 U	82
BA-8-0	26-Oct-11	0	**21**	73	1 U	15	21	16	0.2 U	1 U	72
BA-8-3.5	26-Oct-11	3.5	3.4	99	**9.2**	10	17	**49**	0.2 U	1 U	68
BA-9-0	26-Oct-11	0	**20**	68	1 U	12	13	15	0.2 U	1 U	69
BA-9-3	26-Oct-11	3	2.9	78	1 U	16	17	8.8	0.2 U	1 U	54
BA-9-4	26-Oct-11	4	1.9	110	1 U	23	20	5	0.2 U	1 U	45
BA-9-8.5	26-Oct-11	8.5	2.1	72	1 U	15	15	3.4	0.2 U	1 U	34
BA-10-0	26-Oct-11	0	**13**	120	1 U	11	17	15	0.2 U	1 U	67
BA-10-1	26-Oct-11	1	4.6	90	1 U	17	24	15	0.2 U	1 U	75
BA-10-4.5	26-Oct-11	4.5	**7.6**	120	1 U	17	21	9.9	0.2 U	1 U	56
BA-10-7.5	26-Oct-11	7.5	4.9	110	1 U	18	19	7	0.2 U	1 U	59
BA-11-0	26-Oct-11	0	**7.8**	61	1 U	17	15	16	0.2 U	1 U	77
BA-11-2.5	26-Oct-11	2.5	2.6	110	1 U	22	23	13	0.2 U	1 U	73
BA-11-4.5	26-Oct-11	4.5	**10**	130	1 U	19	20	9.1	0.2 U	1 U	56
BA-11-8.5	26-Oct-11	8.5	**7.6**	110	1 U	20	18	7.6	0.2 U	1 U	59
BA-12-0	25-Oct-11	0	6.7	65	1 U	12	12	5.9	0.2 U	1 U	45
BA-12-2.5	25-Oct-11	2.5	2.5	130	1 U	16	15	9.2	0.2 U	1 U	50
BA-12-7	25-Oct-11	7	4.5	96	1 U	11	17	7.4	0.2 U	1 U	50
BA-13-0	26-Oct-11	0	**7.8**	70	1 U	8.9	10	3.6	0.2 U	1 U	43
BA-13-3.5	26-Oct-11	3.5	1.7	72	1 U	14	19	15	0.2 U	1 U	79
BA-13-7.5	26-Oct-11	7.5	5	99	1 U	11	18	6.7	0.2 U	1 U	55
BA-14-0	25-Oct-11	0	3.1	79	1 U	12	13	**40**	0.2 U	1 U	82
BA-14-2	25-Oct-11	2	1.9	79	1 U	12	13	3.5	0.2 U	1 U	41

Table 3
Analytes Detected in Soil, Metals
Kinder Morgan - Linnton Terminal,
Portland, Oregon

			METALS - SW6020/6020A (mg/kg)								
Sample Name	**Sample Date**	**Sample Depth (feet bgs)**	**Arsenic**	**Barium**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Selenium**	**Zinc**
BA-14-4	25-Oct-11	4	4.8	76	1 U	10	17	6.6	0.2 U	1 U	50
BA-14-7.5	25-Oct-11	7.5	**9.3**	110	1 U	12	22	12	0.2 U	1 U	60
BA-15-0	25-Oct-11	0	3.8	59	1 U	10	11	**20**	0.2 U	1 U	78
BA-15-1.5	25-Oct-11	1.5	2.5	81	1 U	17	15	11	0.2 U	1 U	57
BA-15-8	27-Oct-11	8	**9.1**	110	1 U	16	19	8.6	0.2 U	1 U	61
BA-16-0.5	25-Oct-11	0.5	4.4	140	1 U	20	17	12	0.2 U	1 U	69
BA-16-4	25-Oct-11	4	5.8	110	1 U	16	18	8.6	0.2 U	1 U	55
BA-16-7	25-Oct-11	7	5.4	100	1 U	11	18	7.1	0.2 U	1 U	53
BA-18-0.5	27-Oct-11	0.5	**10**	77	1 U	8.3	16	9.7	0.2 U	1 U	64
BA-18-10	27-Oct-11	10	3.4	79	1 U	8.5	15	5.9	0.2 U	1 U	51
BA-18-2.5	27-Oct-11	2.5	5.3	86	1 U	18	17	9.8	0.2 U	1 U	58
BA-18-4.5	27-Oct-11	4.5	5.3	89	1 U	11	18	8.3	0.2 U	1 U	51

Notes:

mg/kg = milligrams per kilogram

Screening Level Values (SLVs) taken from Table 3-1 of the Portland Harbor Joint Source Control Strategy (JSCS) guidance document, updated July 16, 2007.

Bold = detected result exceeds screening level.

Appendix A – Boring Logs

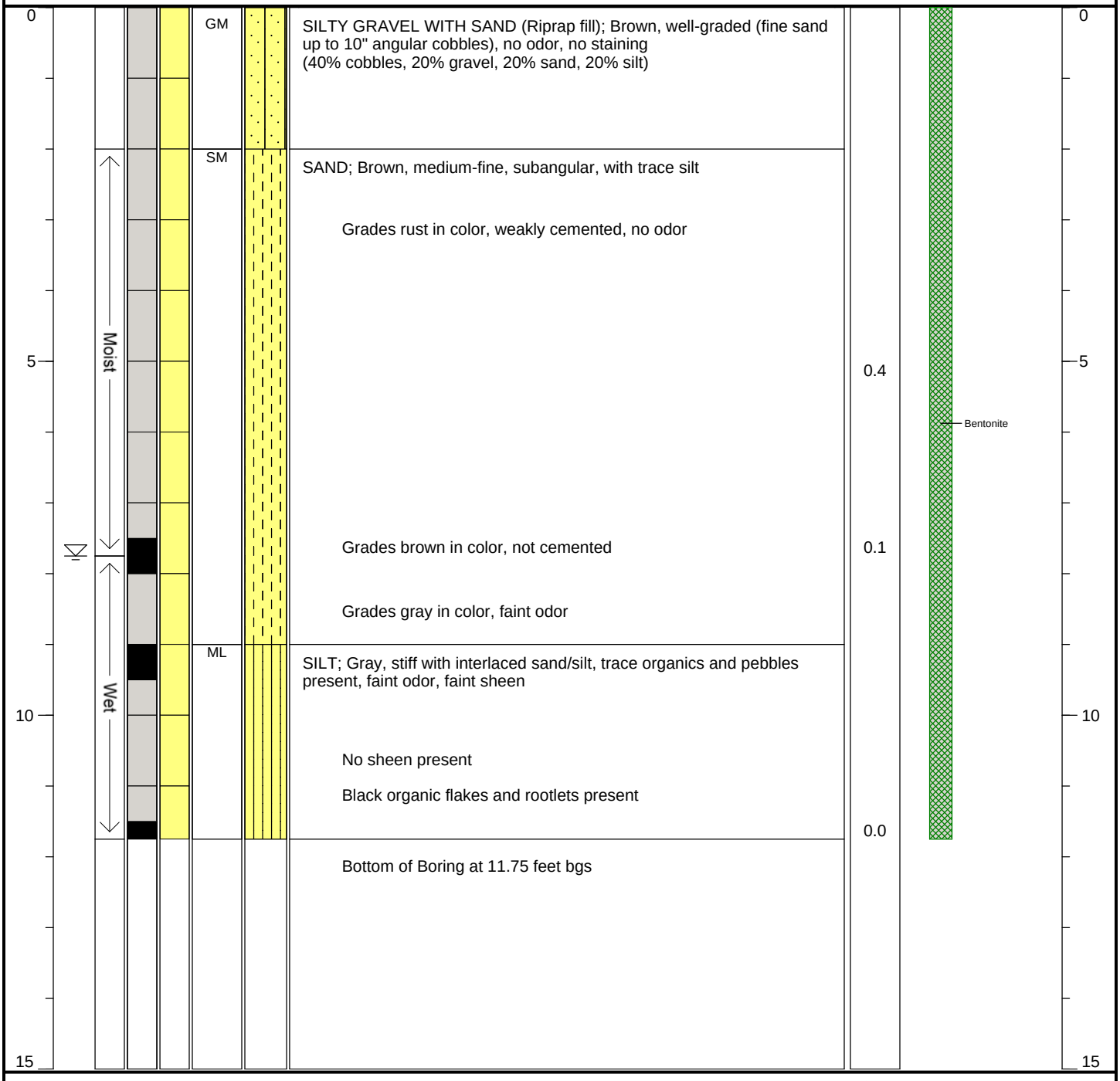
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-1**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/11/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **11.75**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

BORING LOG

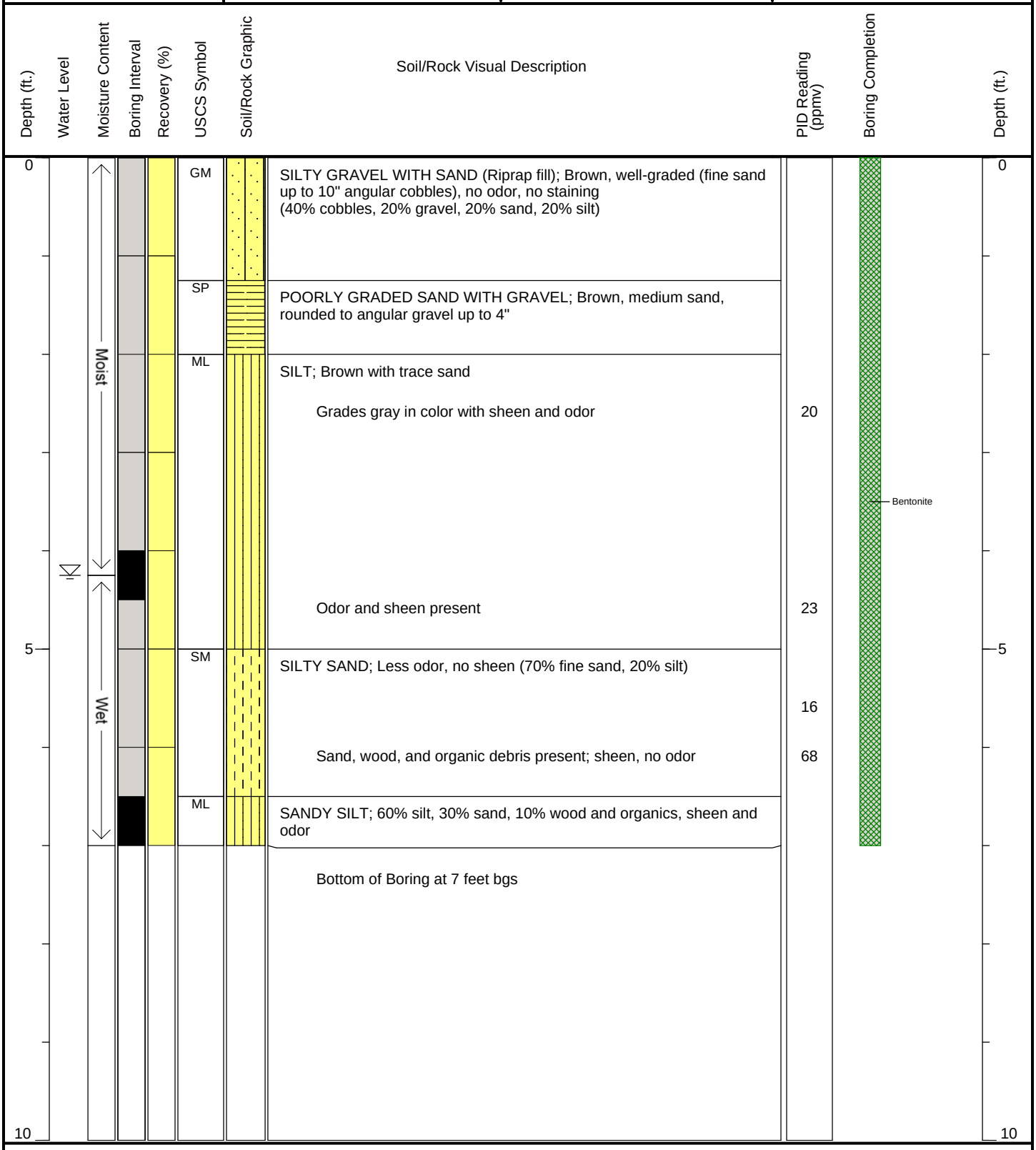
Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No.

BA-2

Site Address:	Drilling Date(s): **11/11/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
11400 NW St. Helens Rd.	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
Portland, OR	Drilling Method: **Hand Auger**	Boring Depth (ft): **7**	Screen slot size: **N/A**
Logged By: **NWH**	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

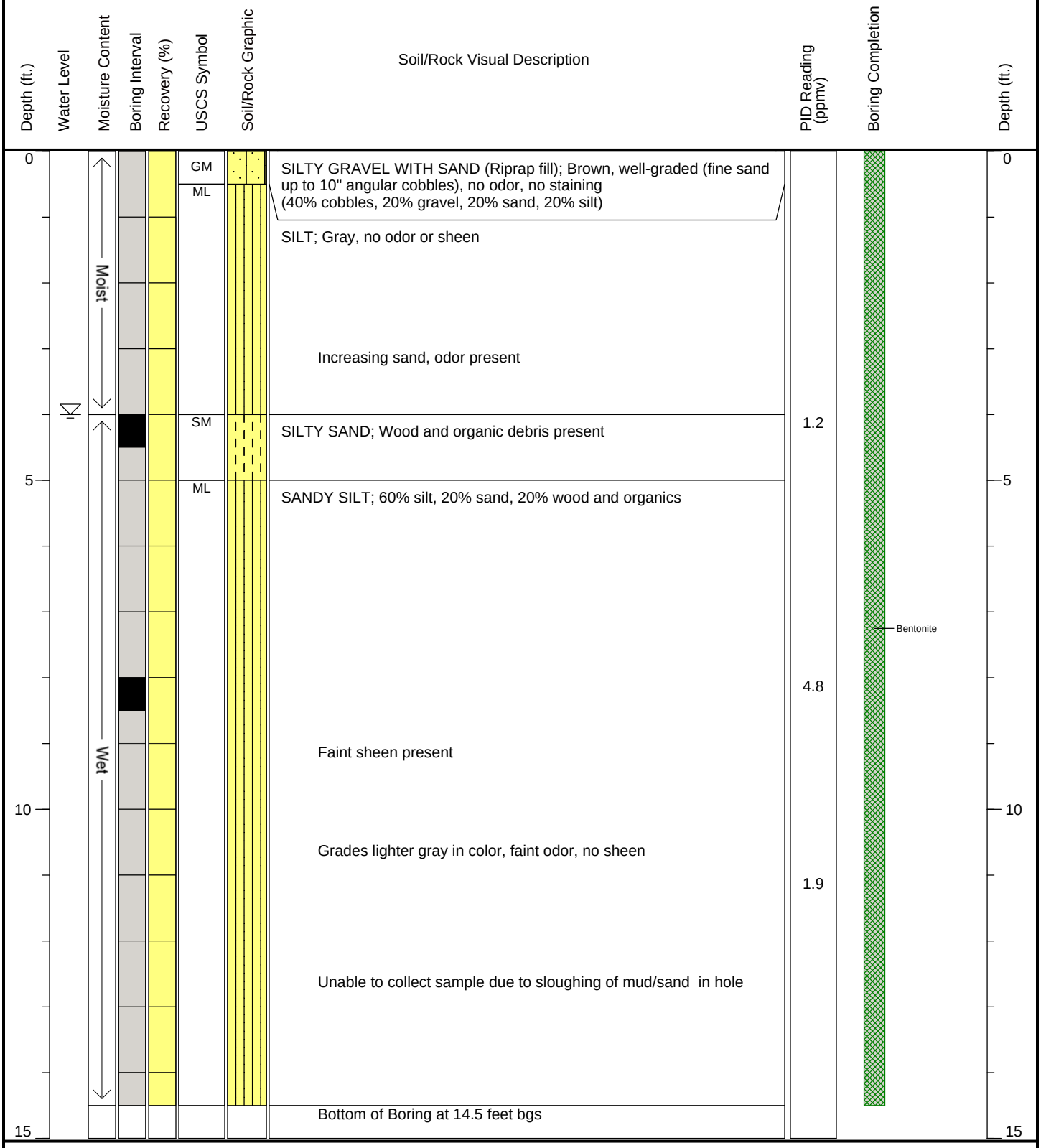
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-3**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/9/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **14.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

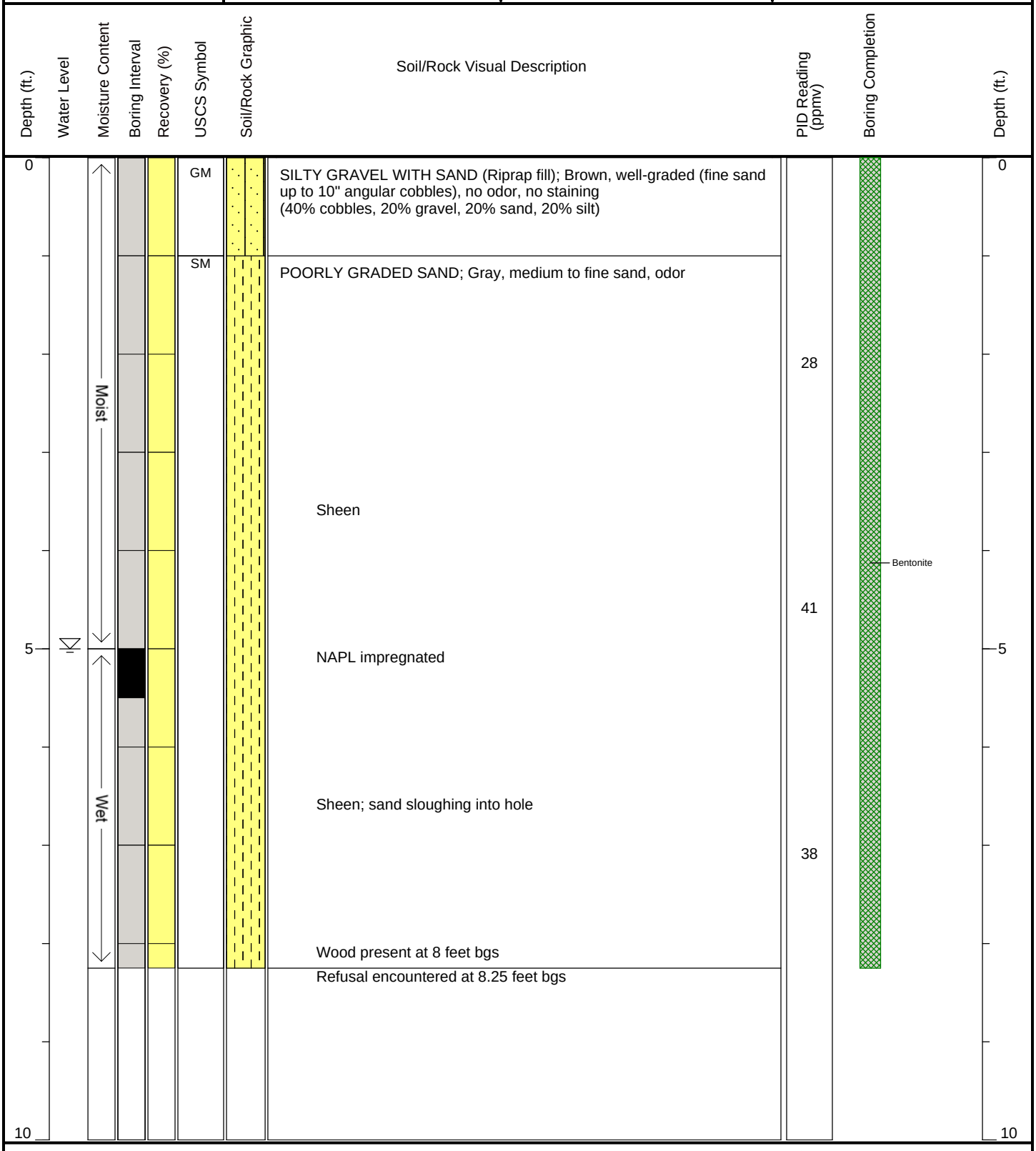
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-4**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/9/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **8.25**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

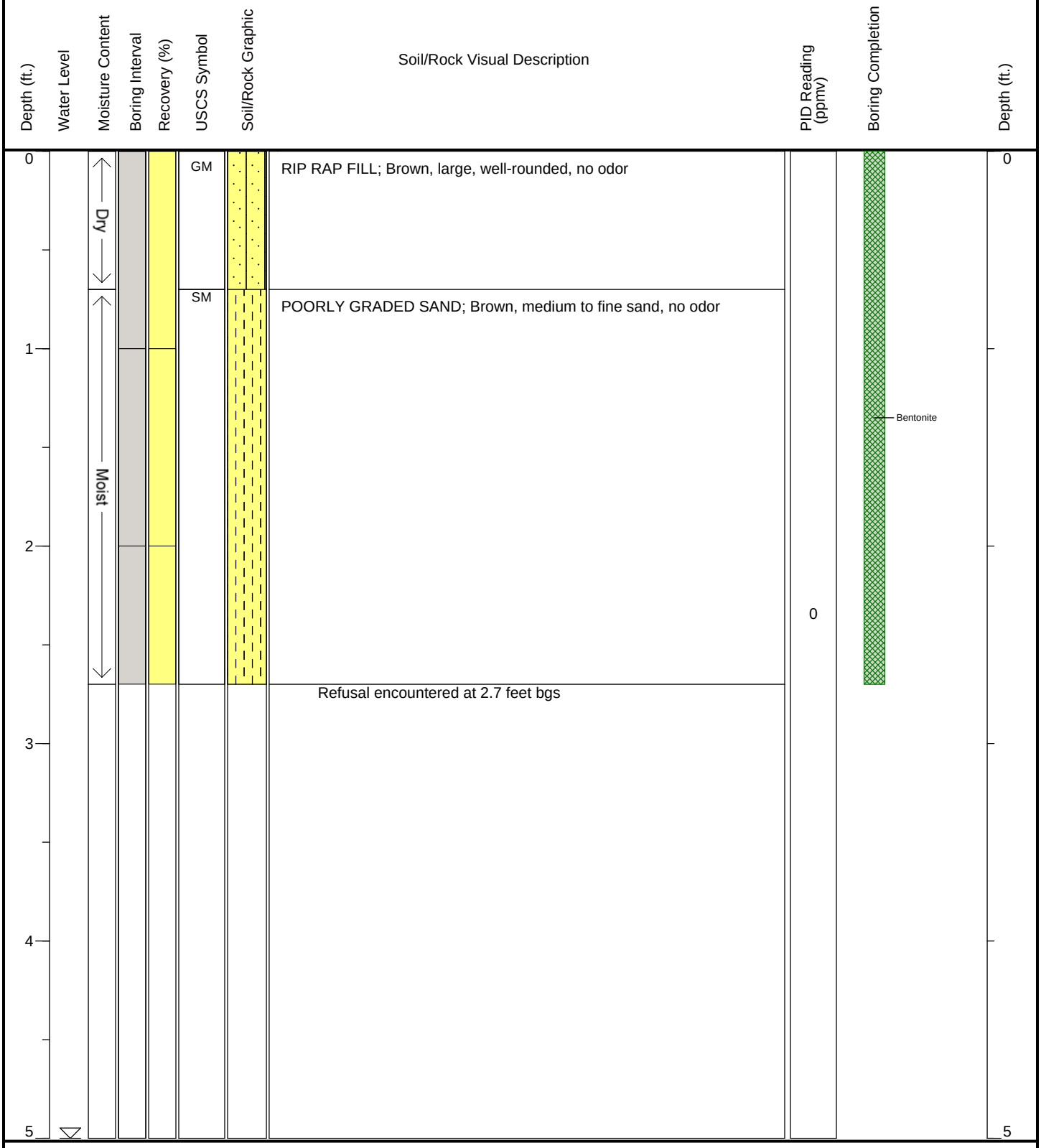
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-4A**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/9/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **2.7**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No.

BA-4A

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/9/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **2.7**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**

Depth (ft.)	Water Level	Moisture Content	Boring Interval	Recovery (%)	USCS Symbol	Soil/Rock Graphic	Soil/Rock Visual Description	PID Reading (ppmv)	Boring Completion	Depth (ft.)

■ Sample Collected

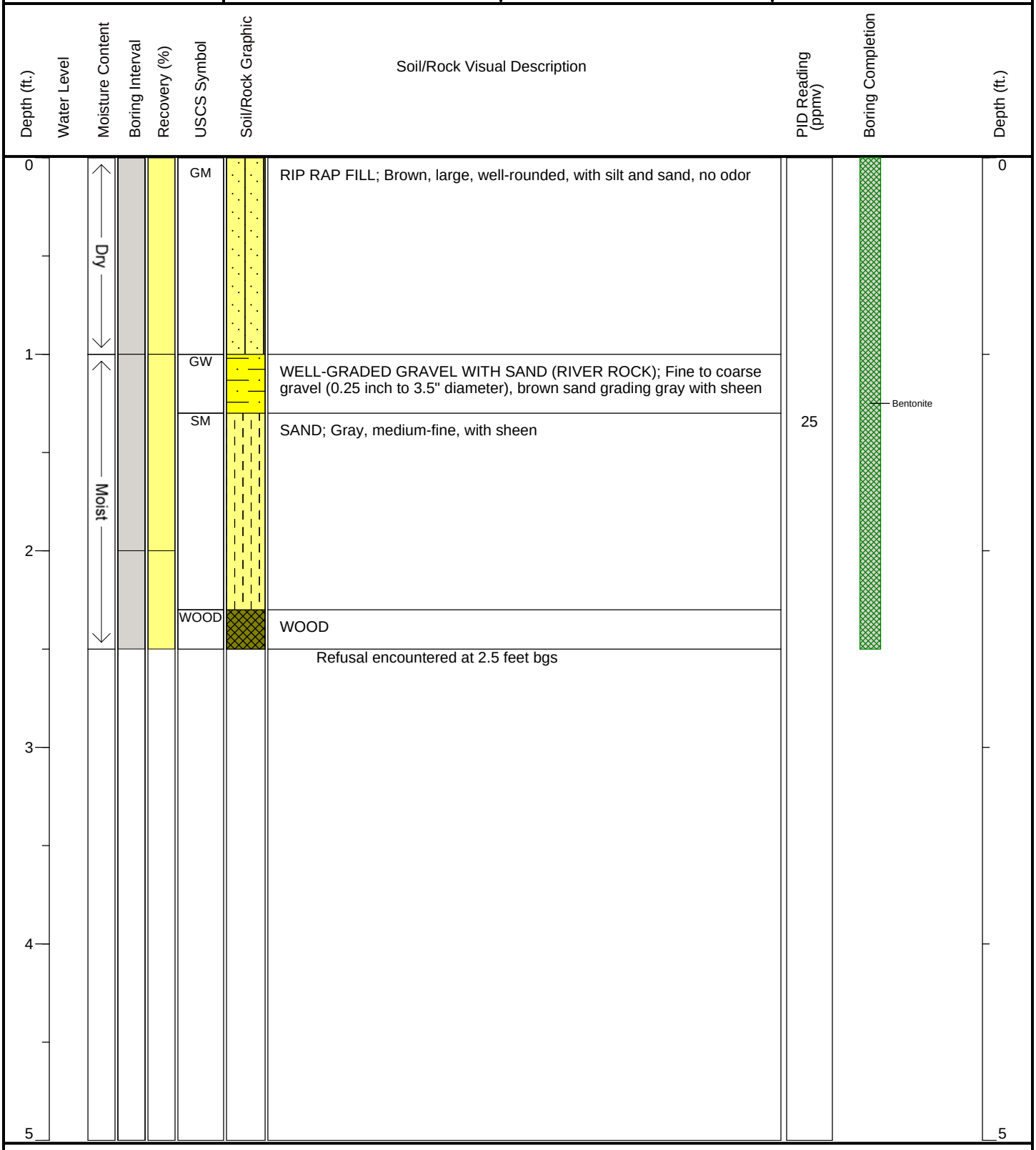
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-4B**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/9/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **2.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



■ Sample Collected

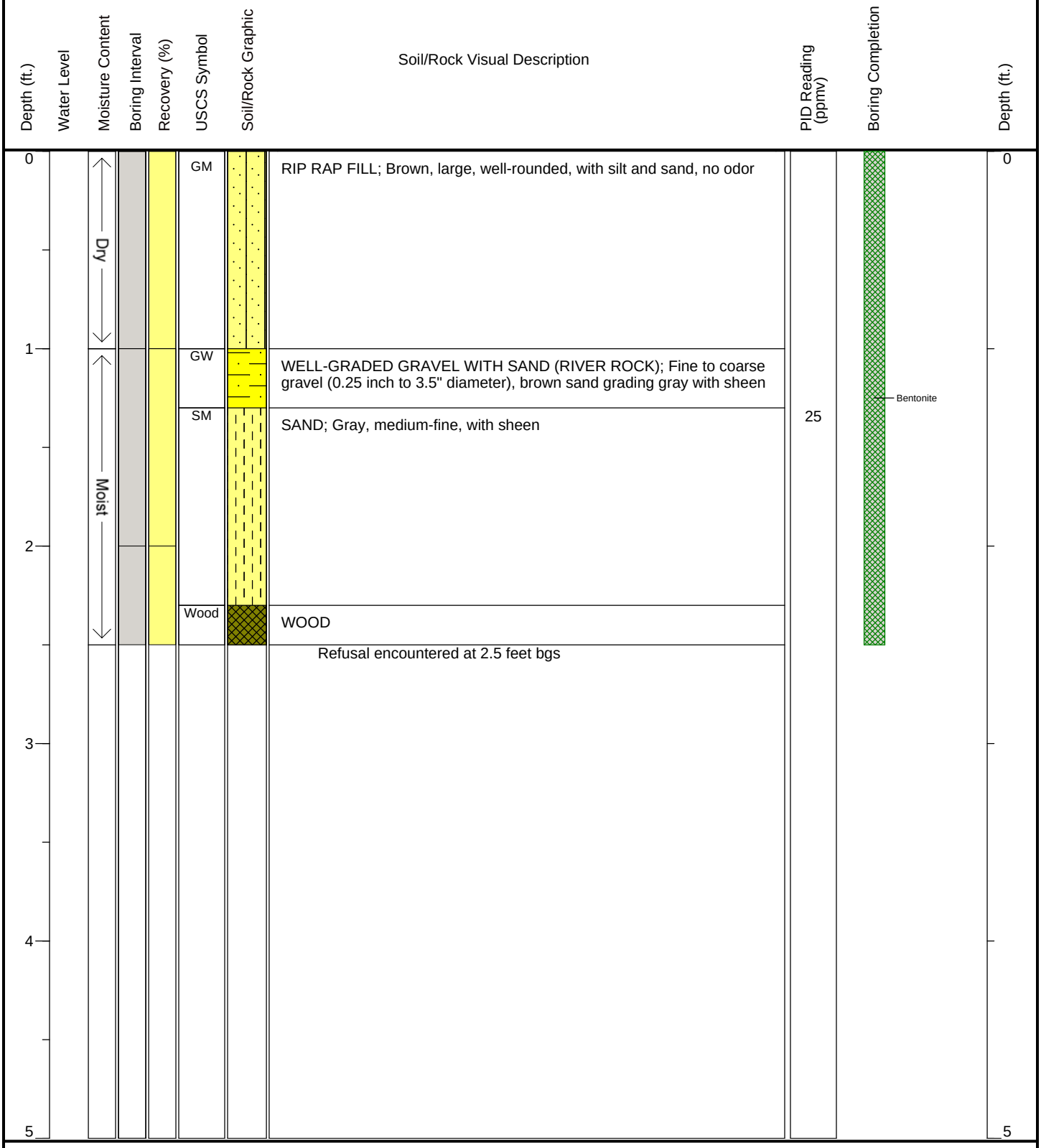
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-4C**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/9/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **2.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

BORING LOG

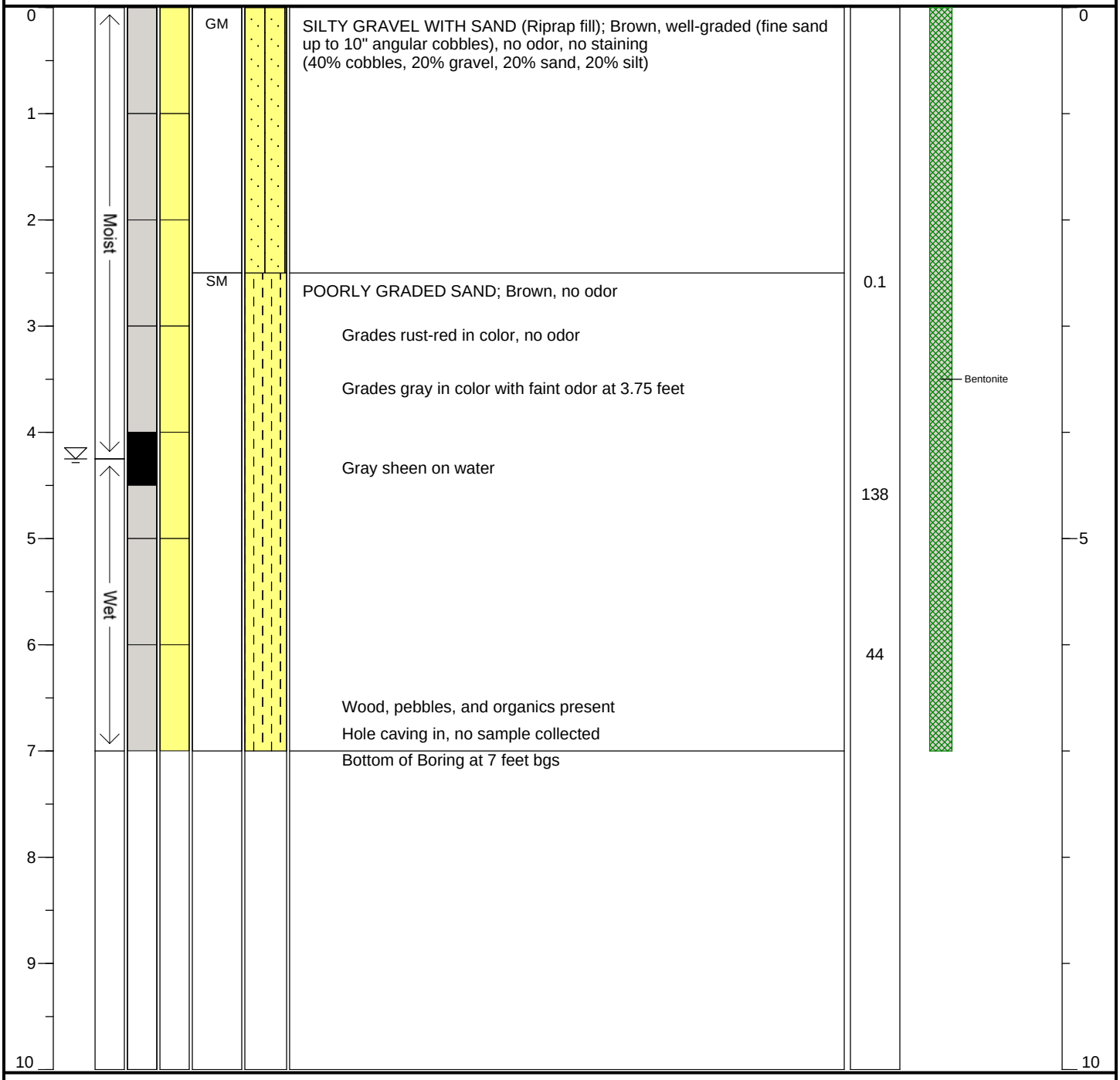
DELTA

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-5**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/12/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **7**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

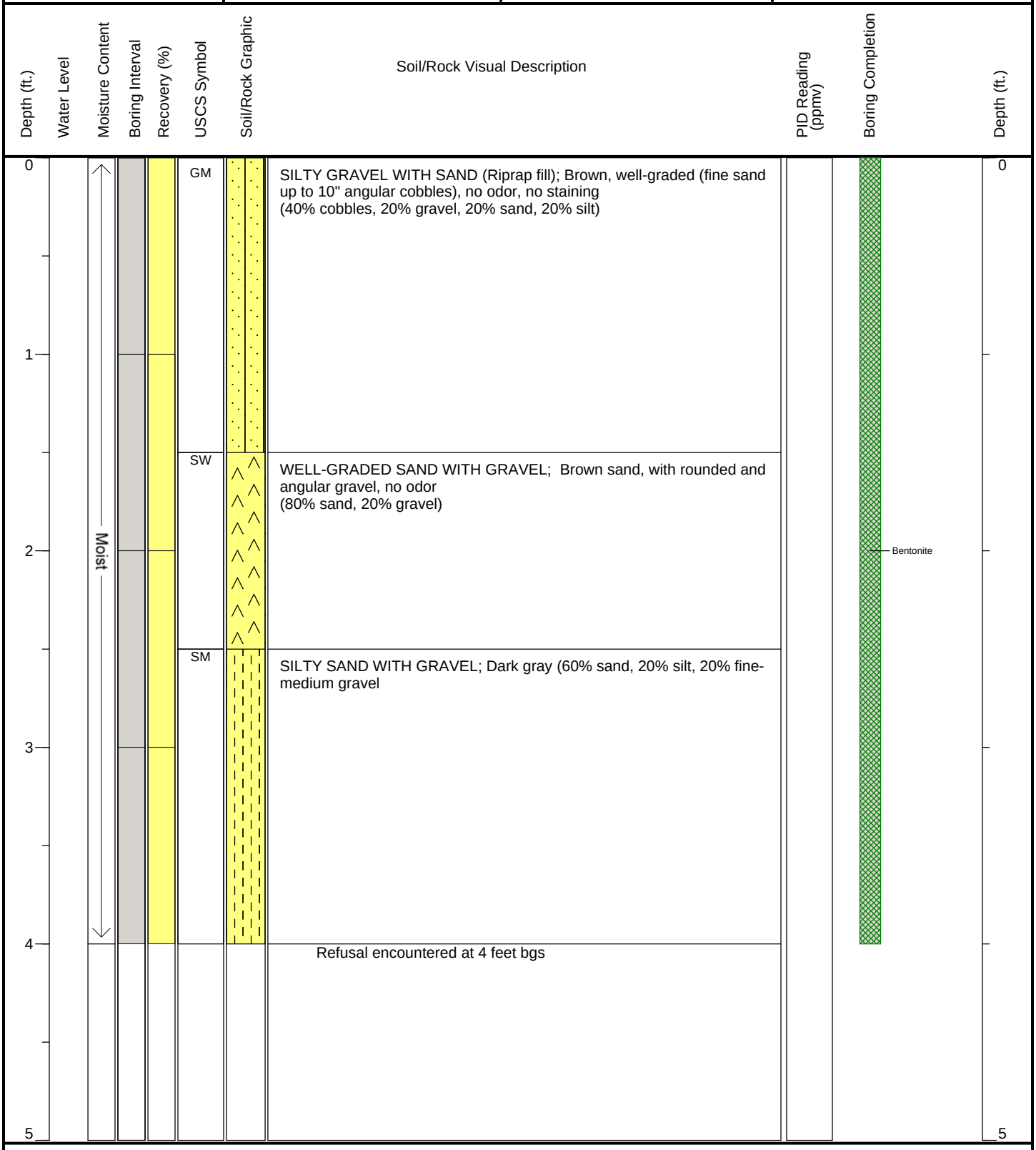
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-5A**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/12/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **4**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

BORING LOG

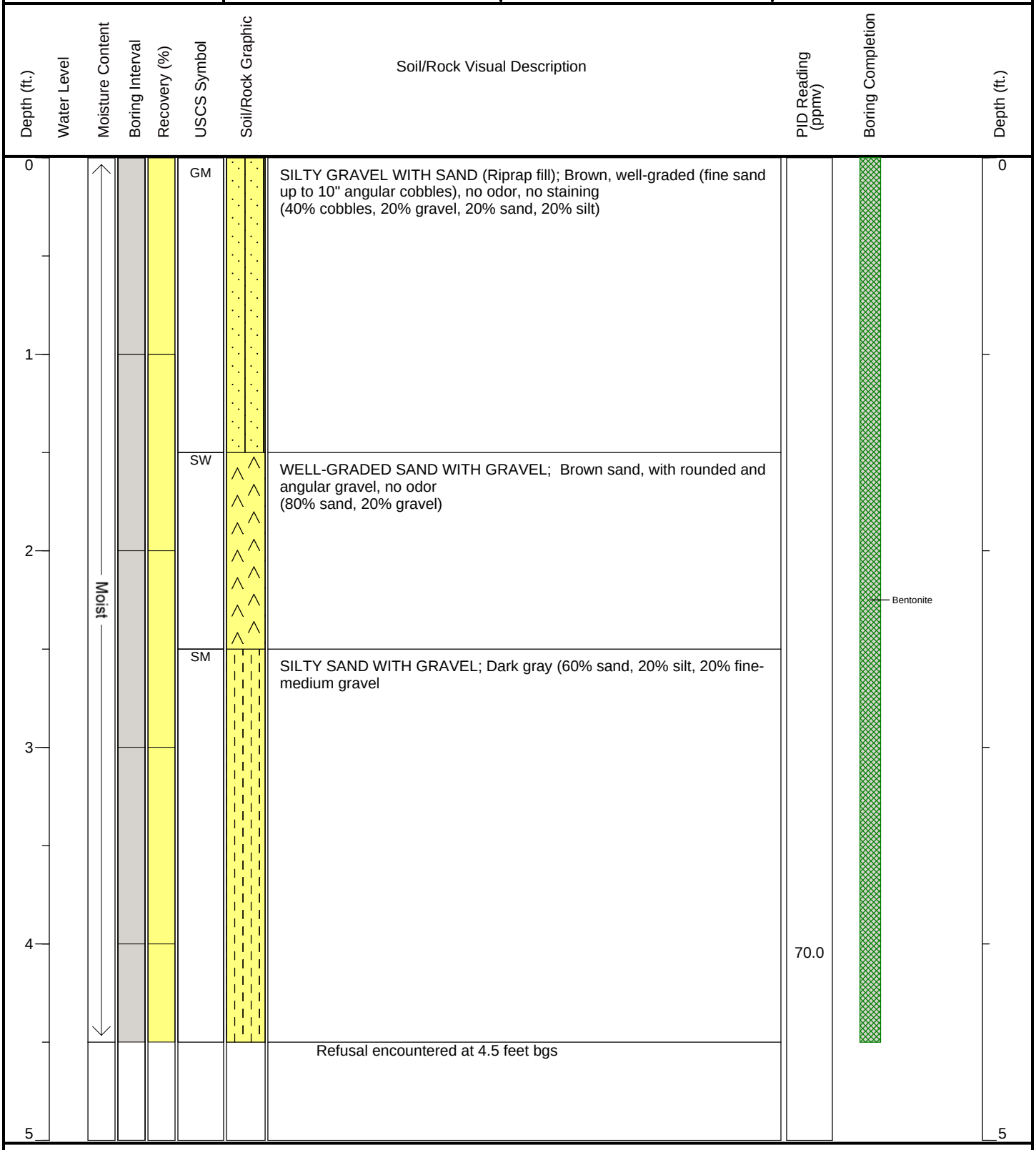
DELTA

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-5B**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/12/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **4.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

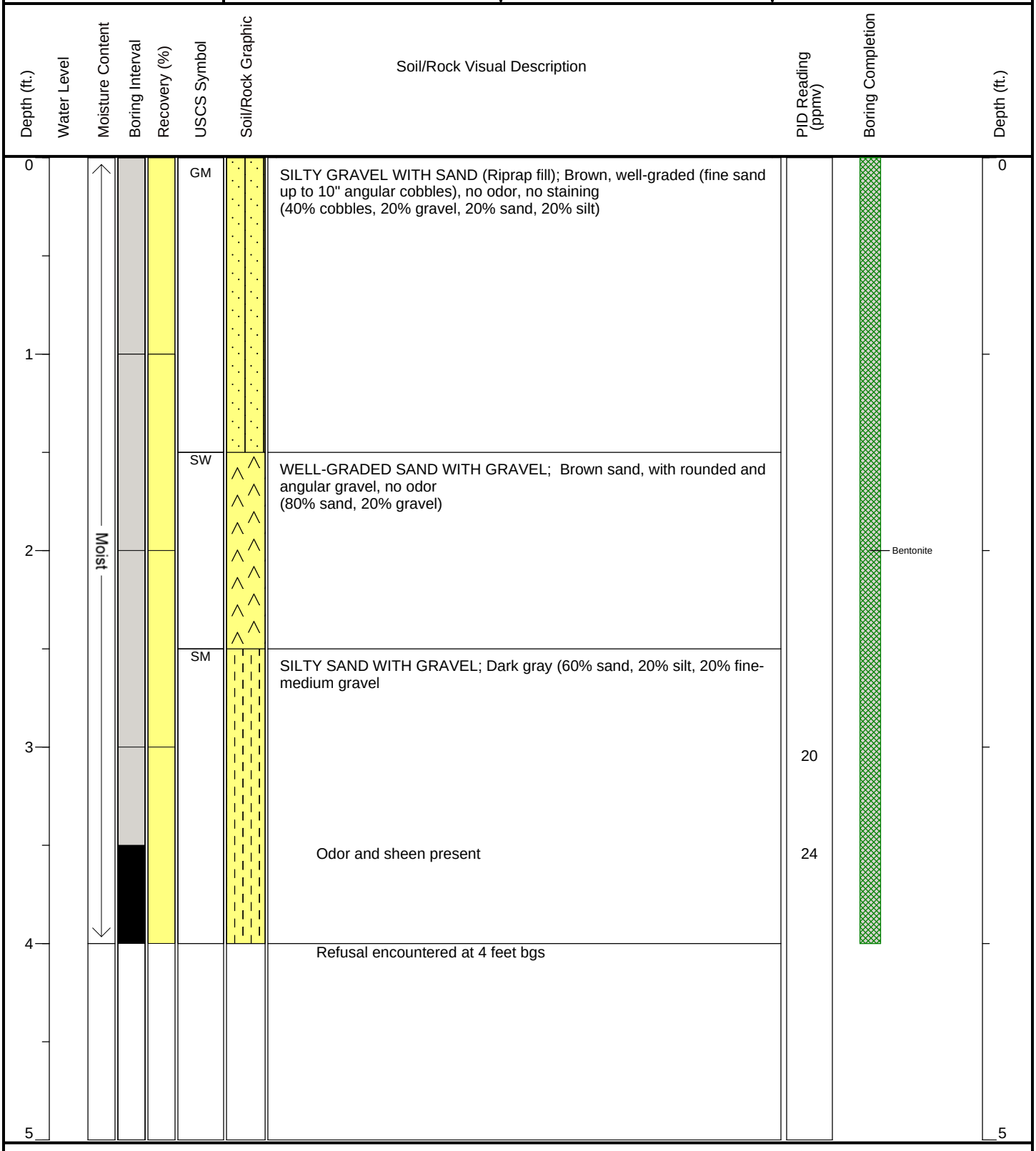
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-5C**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/12/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **4**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

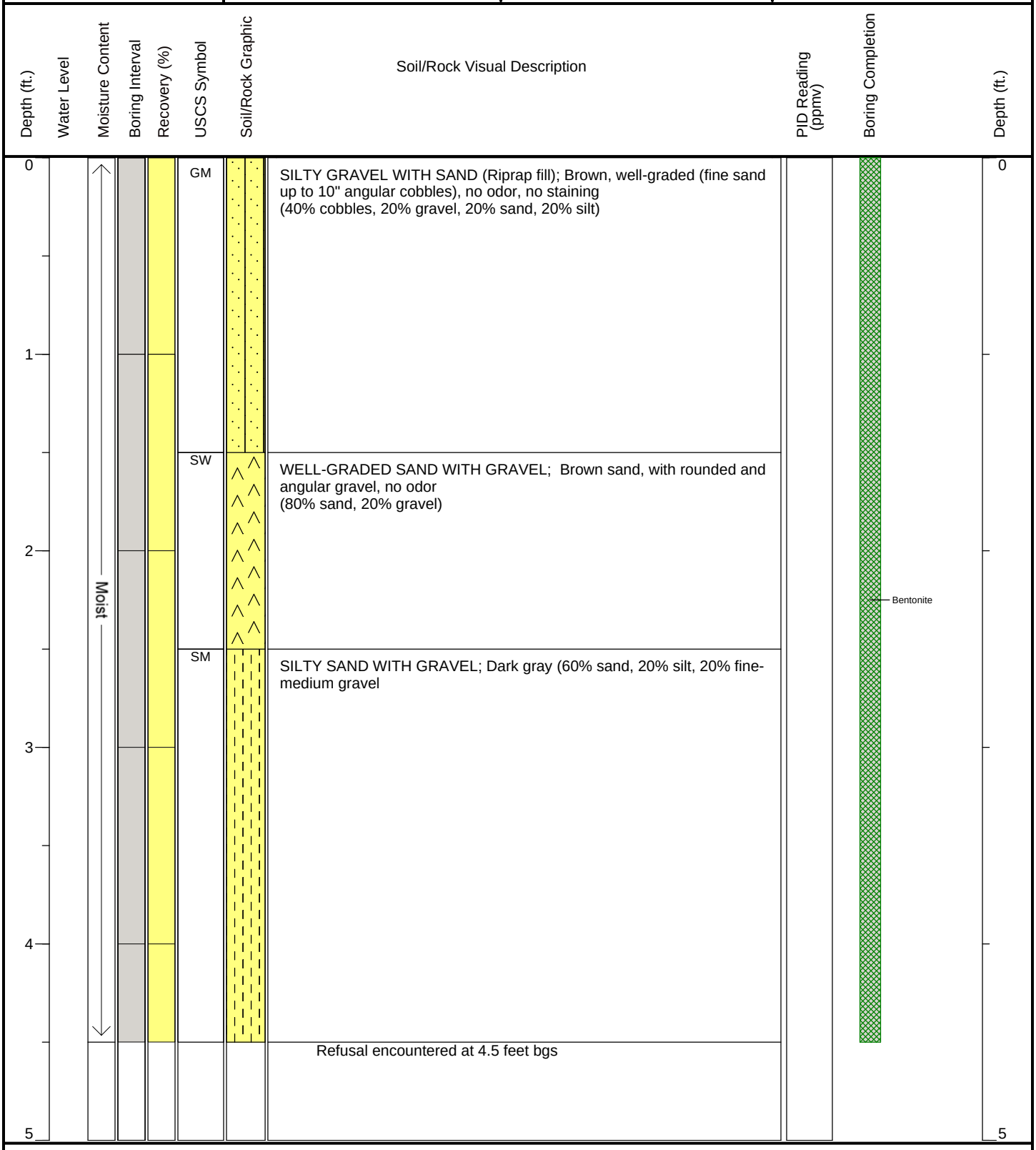
BORING LOG

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-5D**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/12/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **4.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

BORING LOG

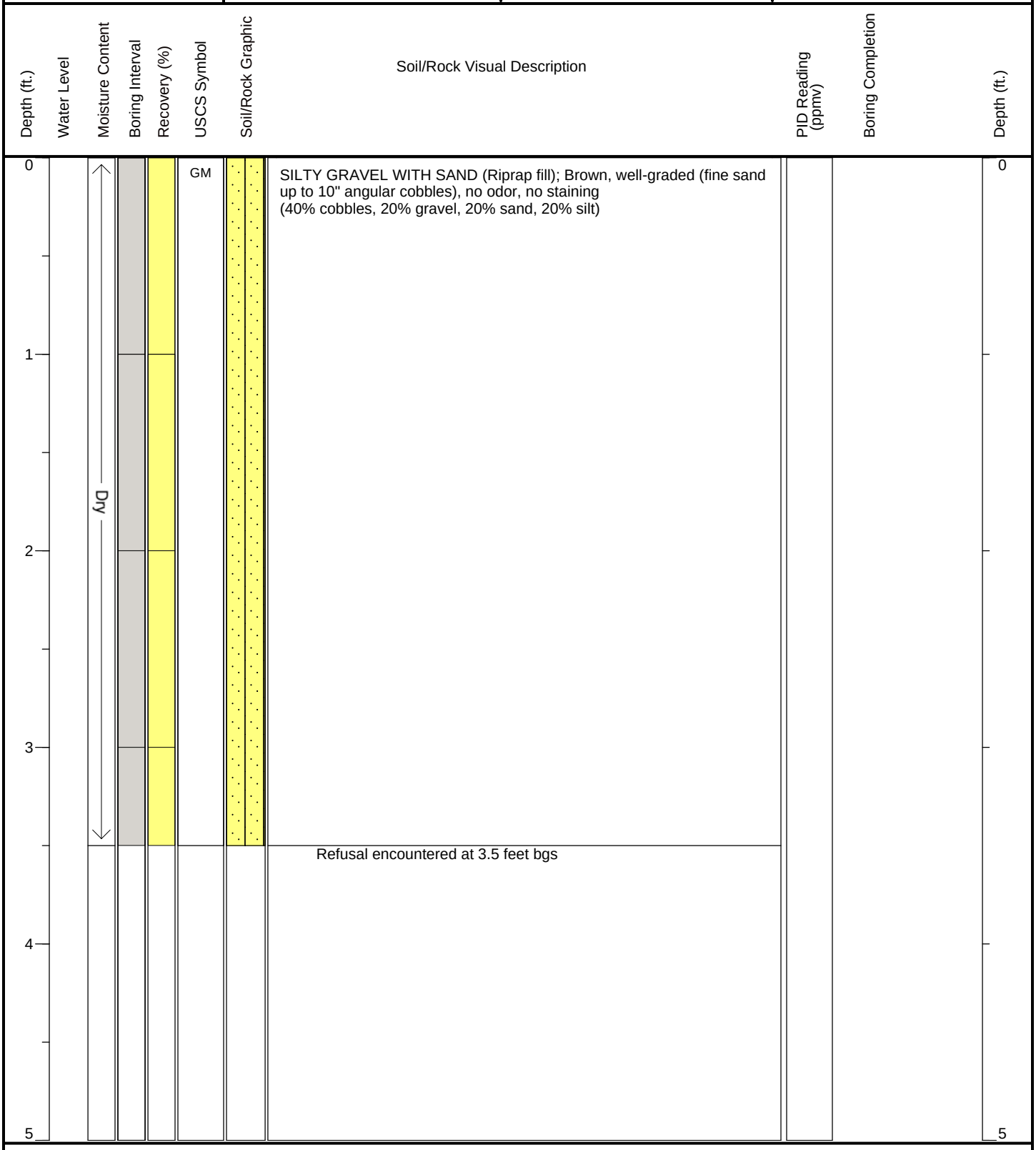
DELTA

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-5E**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/12/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **3.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



■ Sample Collected

BORING LOG

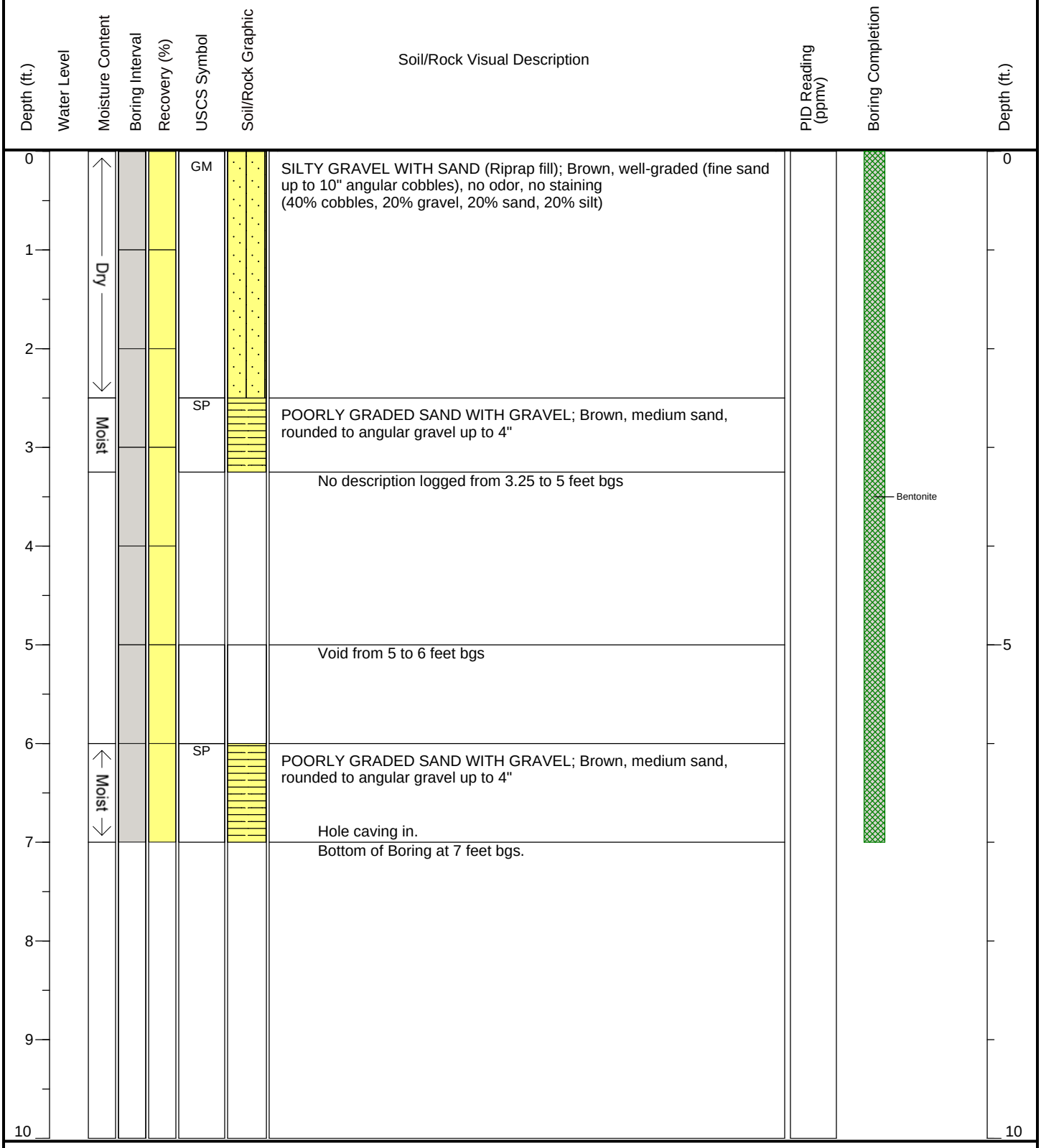
DELTA

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-6A**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/11/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **7**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

BORING LOG

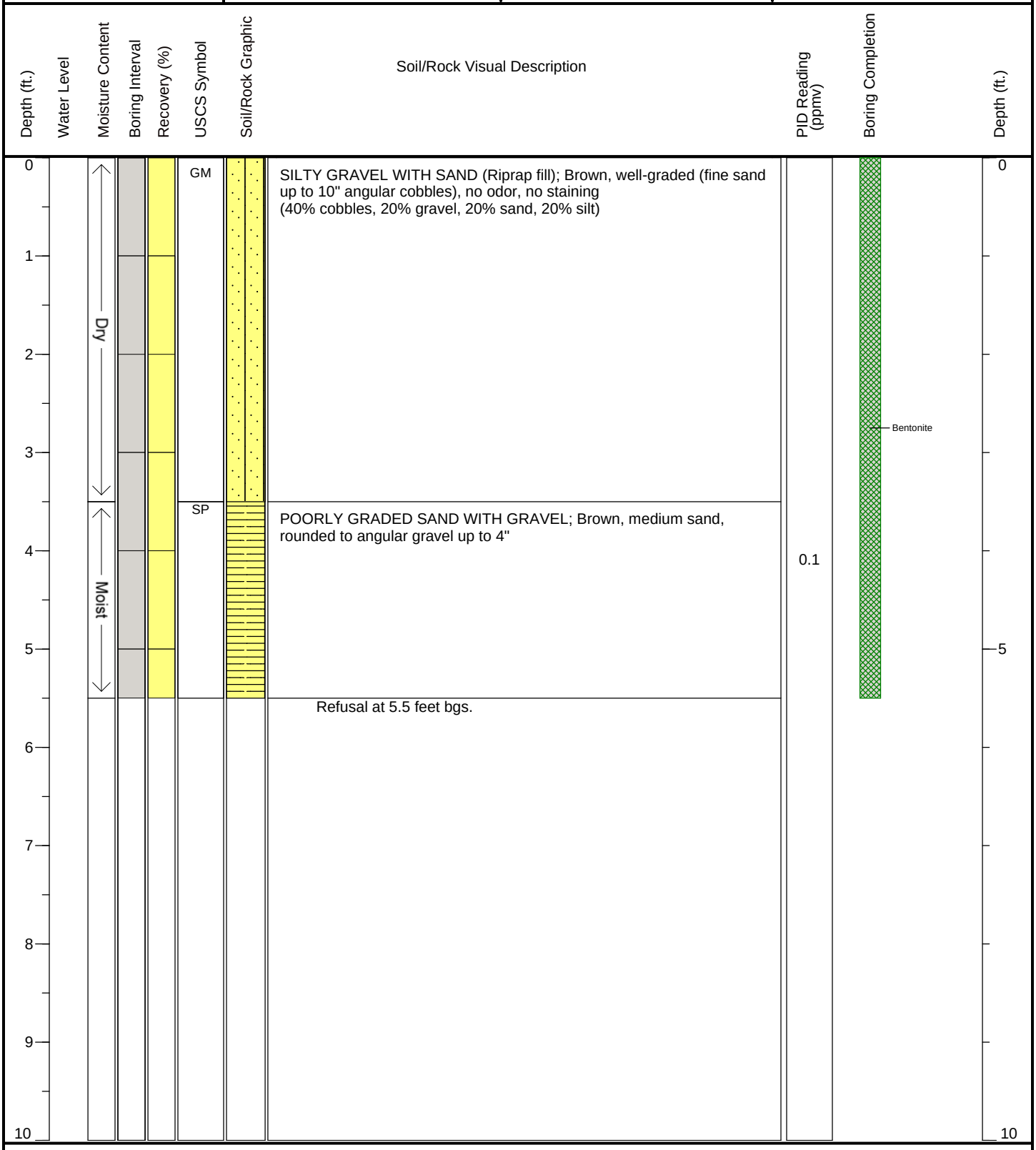
DELTA

Client: **Kinder Morgan**

Project Number: **KM LIN 10-03**

Boring/Well No. **BA-6B**

Site Address: **11400 NW St. Helens Rd. Portland, OR**	Drilling Date(s): **11/11/10**	Boring diameter (in.): **3.5**	Casing Material: **N/A**
Logged By: **NWH**	Drilling Company: **Delta Consultants**	Casing Diameter (in.): **N/A**	Screen Interval: **N/A**
	Drilling Method: **Hand Auger**	Boring Depth (ft): **5.5**	Screen slot size: **N/A**
	Sampling Method: **Grab**	Well Depth (ft.): **N/A**	Sand Pack: **N/A**



Sample Collected

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-07	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation
LOCATION : Kinder Morgan - Linnton Terminal
ELEVATION : N/A
Sample Collection : Hand-augered by Antea Group
DRILLING METHOD AND EQUIPMENT USED : Hand-auger
WATER LEVELS : N/A
START : 10/26/11 END : 10/26/11
LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 10.5	~95%	NA	NA	0.0': Poorly Graded Sand (SP), brown, moist, loose, fine to medium grained 0.2': 2.3" thick zone of orange oxide stained sand 0.6': sand becomes gray 2.0': Grades to Sandy Silt (ML), dark gray, saturated, soft 2.5': Grades to Silty Sand (SM), dark gray, wet, loose, fine to medium grained 4.75': Silt (ML), green, moist, medium stiff 6.0': Becomes soft, some light gray mottling 6.5': Grades to brown/gray in color Brown only by 7.0' bgs No recovery 8.0-10.5'	BA-07-0 (0-0.5) PID = 0.0 ppm water enters borehole ~0.8' cased off borehole to ~4.0' BA-07-4 (4.0-4.5) PID = 5.5 ppm Impacts: 0.0: none observed 0.6': slight odor 2.0': sheen with strong odor 4.75': odor 7.0': none observed
5.0						
10.0						
					End of Boring at 10.5' bgs	
15						
20.0						

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-08	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/26/11 — END : 10/26/11 — LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 9.0	~75%	NA	NA	0.0': Poorly Graded Sand (SP), brown, loose 0.4': 1"-2" orange oxide stained sand 0.5': Medium to Well Graded Sand, gray to dark gray, fine to medium grained 4.0-6.0': Water entering hole - little recovery - green stiff silt observed ~5.0' bgs, sand and silt debris observed 8.0': Silt (ML), grayish brown tint observed, medium stiff, some rooty debris	BA-08-0 (0-0.5) PID = 0.0 ppm 0.8': Water entering hole, cased to ~4.5' water entering casing, drive casing to ~5.0' BA-08-3.5 (3.5-4.0) PID = 13.2 ppm sand heaving into borehole, cannot get representative sample Impacts: 0.0: none observed 0.5': very slight odor 1.5': sheen ~4.5': odor 4.5-7.5': hard to determine based on heaving sands 7.5': silt observed with little to no staining
5.0						
10.0					End of Boring at 9.0' bgs	
15						
20.0						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-09	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/26/11 — END : 10/26/11 — LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 9.0	~95%	NA	NA	0.0': Poorly Graded Sand (SP), brown to strong brown, dry to moist, fine to medium grained 0.5': ~2-3" of orange oxide staining 0.8': Gray sand 2.0': Grades to Silt (ML), gray, soft to stiff, trace sand present 4.5': Grades to Silt (ML), little to no trace sand, medium stiff to stiff 7.0': Grades to gray/brown Silt (ML), soft to medium stiff, medium plasticity 7.5': Begins to grade from gray to brown 8.0': Mostly brown in color, trace sand present, medium stiff	BA-09-0 (0-0.5) PID = 0.0 ppm BA-09-3 (3.0-3.5) PID = 48.4 ppm BA-09-4 (4.0-4.5) PID = 6.8 ppm BA-09-8.5 (8.5-9.0) PID = 0.0 ppm water at ~1.0', cased to ~4.0'
5.0						
10.0					End of Boring at 9.0' bgs	Impacts: 0.1': none observed 1.0': faint odor 3.0': very slightly impregnated 3.5': slight to moderate sheen 4.5': faint odor 7.5': none observed or water in bucket, 1-2 mm slab
15						
20.0						

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-10	SHEET 1 OF 1

CH2MHILL

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/26/11 — END : 10/26/11 — LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 8.0	~95%	NA	NA	0.0': Sand (SP), brown, moist, loose 0.75': becomes gray and wet 1.2': Grades to Silty Sand (SM) to Sandy Silt (ML), gray, soft, wet 3.0': Sand begins grading out 3.25': Grades to Silt (ML), stiff, brown to grey, wet 3.5': Color becomes uniformly brown to light brown 5.0 ocassional sandy silt zone present below 4.5	BA-10-0 (0-0.5) PID = 0.0 ppm BA-10-1 (1.0-1.5) PID = 20.2 ppm BA-10-4 (4.5-5.0) PID = 0.0 ppm BA-10-7.5 (7.5-8.0) PID = 0.1 ppm water at ~0.75', cased to ~3.0'
					End of Boring at 8.0' bgs	Impacts: 0.0': none observed 0.75': faint odor 0.85': light sheen 2.0': faint odor 3.5': none observed
10.0						
15						
20.0						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-11	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation
LOCATION : Kinder Morgan - Linnton Terminal
ELEVATION : N/A
Sample Collection : Hand-augered by Antea Group
DRILLING METHOD AND EQUIPMENT USED : Hand-auger
WATER LEVELS : N/A
START : 10/26/11 END : 10/26/11
LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 9.0	~90%	NA	NA	0.0': Sand (SP), brown, dry to moist, trace cobble-boulder (from rip rap) 1.0': ~2" of orange oxide staining 1.5': Grades to Silty Sand (SM), silt content increasing with depth 3.3': Becomes Silt (ML), gray, soft 4.0': Become stiff Silt (ML), color grading to brown, organic debris at ~4.5' 4.5': Becoming medium stiff	BA-11-0 (0-0.5) PID = 0.0 ppm BA-11-2.5 (2.5-3.0) PID = 1.8 ppm water entering hole @ 2.25' bgs, drive temporary casing to ~3.5' bgs, lots of water still entering, drive 5.0' casing, water at ~5.0-6.0', clean industrial debris discovered at ~2.5' bgs, may have sluffed in BS-1B-4.5 (4.5-5.0) PID = 0.0 ppm BA-11-8.5 (8.5-9.0) PID = 0.0 ppm
5.0						
10.0					End of Boring at 9.0' bgs	Impacts: 0.0: no impact observed 2.0': odor 2.5': very slight sheen 3.0': odor 4.5': none observed
15						
20.0						

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-12	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/25/11 — END : 10/25/11 — LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 7.5	~95%	NA	NA	0.0': Gravel 0.2': Sand with Trace Gravel (SP), brown, moist, loose, moderately sorted, subrounded, fine grained 1.0': Sand (SP), gray, saturated 3.5': Silt (ML), gray, saturated, soft, organic debris at top of layer 4.5': Grades to brown to gray 5.0': Brown in color, no staining	BA-12-0 (0-0.5) PID = 0.0 ppm water enters borehole ~1.0' sheen observed on water, some product observed on water Headspace PID = 34.1 ppm BA-12-2.5 (2.5-3.0) Headspace PID = 0.0 ppm sampled moist, impacted soil BA-12-7.0 (7.0-7.5) Headspace PID = 0.0 ppm shallow soils cased to ~3.0', potential cross contamination from water entering borehole - soil core rinsed with deionized water prior to sampling Impacts: 0.0: none observed 1.0': odor and staining 1.5': slight sheen to impregnated 3.5': odor and staining 4.5': odor 5.0': none visible
5.0						
10.0					End of Boring at 7.5' bgs	
15						
20.0						

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-13	SHEET 1 OF 1

CH2MHILL

SOIL BORING LOG

PROJECT : Bank Soils Investigation
LOCATION : Kinder Morgan - Linnton Terminal
ELEVATION : N/A
Sample Collection : Hand-augered by Antea Group
DRILLING METHOD AND EQUIPMENT USED : Hand-auger
WATER LEVELS : N/A
START : 10/25/11 END : 10/25/11
LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 8.0	~90%	NA	NA	0.0': Sand (SP), brown, moist, rounded, poorly graded 1.0': Sand (SP), becomes gray to brown in color 2.5': Sandy Silt (SM), dark gray to gray, soft, wet, wood debris present 4.5': Becomes light brown, wet and medium stiff, some sandy intervals present	BA-13-0 (0-0.3) PID = 0.0 ppm water entering borehole at ~0.5', cased to ~5.0' bgs, some water entering borehole from below cased off portion (~5.0' bgs cased) BA-13-3.5 (3.5-4.0) PID = 3.1 ppm BA-13-7.5 (7.5-8.0) PID = 0.1 ppm
5.0						
10.0					End of Boring at 8.0' bgs	Impacts: 0.0: none observed 1.0': odor 2.5': very slight sheen 4.0': odor 4.5': none
15						
20.0						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-14	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/25/11 — END : 10/25/11 — LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 8.0	~90%	NA	NA	0.0': Well Graded Gravel with Sand (GW), cobbles and boulders in sandy matrix, black, moist	BA-14-0 (0-0.5) PID = 33.2 ppm
					2.0': Grades to Sand (SW), black, wet, loose with trace gravel	BA-14-2 (2.0-2.5) PID = 138 ppm 2.5: water 3.0: water with slight sheen entering hole (cased to ~3.5')
5.0					3.75': Silt (ML), black, wet, soft 4.0': Sand content increasing to Sandy Silt - Silty Sand (SM-ML), black, wet	BA-14-4 (4.0-4.5) PID = 6.4 ppm 5.5': water flowing in under casing, odor
					7.0': Color grades to brown	BA-14-7.5 (7.5-8.0) PID = 0.0 ppm
10.0					End of Boring at 8.0' bgs	Impacts: 0.0': sheen 2.5': odor 4.0': sheen, and locally impregnated in occasional 2-4 mm pockets 4.5': sheen 5.5': odor 7.0': none observed
15						
20.0						

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-15	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/27/11 — END : 10/27/11 — LOGGER : N. Hemphill

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 8.0	~95%	NA	NA	0.0': Poorly Graded Sand (SP), brown to gray, moist, fine to medium grained, well sorted, trace round gravel 0.5': Gray in color with faint odor 2.5': Rock/gravel at 2.5' 3.5': Grades to fine Sand (SP), flowing, wet, loose, faint to no odor 5.0': Fine gray flowing sand, silty, water bearing, faint to no odor 6.0': Grading to lighter gray Sandy Silt (SM), high wood content (~20%), some brown and gray mottling	BA-15-0 (0-0.5) PID = 0.0 ppm water coming into hole ~0.5' bgs cased off hole to ~4.5' BA-15-1.5 (1.5-2.0) PID = 1.5 ppm Impacts: 0.0: none visible 0.5': odor 1.5': sheen BA-15-8* (8.0 - 8.5) *soil sample may be cross contaminated with soil from above (<3%) - soil rinsed with distilled water prior to sampling. 8.5': no recovery, too much flowing sand at depth below casing
5.0						
10.0					End of Boring at 8.0' bgs	Impacts: 0.0: none 1.0': slight odor, no split 3.5': anoxic odor 6.0': none
15						
20.0						

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-16	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation — LOCATION : Kinder Morgan - Linnton Terminal

ELEVATION : N/A — Sample Collection : Hand-augered by Antea Group

DRILLING METHOD AND EQUIPMENT USED : Hand-auger

WATER LEVELS : N/A — START : 10/25/11 — END : 10/25/11 — LOGGER : H. Schulz

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 7.5	~95%	NA	NA	0.0': Sand (SW), with gravel, saturated to moist 0.5': Trace cobble present, becomes gray and saturated 2.0': Silt (ML), gray, saturated, soft 3.5': Silt becomes brown, moist, medium stiff 4.0': Trace medium to coarse grained sand ~4.0'	BA-16-0.5* (0-1.5) PID = ppm *sample representative of sheen layer ~1.0-2.0'
5.0					6.5': Grades to Sandy Silt (SM), (water bearing), stiff	BA-16-4 (4.0-4.5) PID = 0.0 ppm
					End of Boring at 7.5' bgs	BA-16-4 (7.0-7.5) PID = 0.0 ppm Impacts: 0.0: none visible 0.5': odor 1.0': sheen 2.0': odor 3.5': non visible
10.0						
15						
20.0						

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
423101.01.02	BA-18	SHEET 1 OF 1

SOIL BORING LOG

PROJECT : Bank Soils Investigation
LOCATION : Kinder Morgan - Linnton Terminal
ELEVATION : N/A
Sample Collection : Hand-augered by Antea Group
DRILLING METHOD AND EQUIPMENT USED : Hand-auger
WATER LEVELS : N/A
START : 11/27/11 END : 11/27/11
LOGGER : N. Hemphill

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	#/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	CORE DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION.
0	0 - 10.5	~85%	NA	NA	0.0': Heavy rock 0.8': Crushed Basalt with rounded cobbles to sand, some silt, brown/red to gray, scrap metal and debris and glass	BA-18-0.5 (0.5 - 1.0)
					2.2': Sandy Silt (SM), dark gray, loose, non plastic	BA-18-2.5 (2.5 - 3.0)
					2.6': Silt (ML), green to gray, stiff, very low plasticity	
5.0					4.0': becomes gray to brown mottled and stiff.	BA-18-4.5 (4.5 - 5.0)
					becomes light brown in color	
					grades to higher content of fine sand	
					9.0': grades to Silty Sand (SM), brown, fine grained, loose, mica flakes, sand flowing	
10.0						BA-18-10 (10.0-10.5) Note: 2 gpm water flowing into gravel hole around casing, hole staying dry inside casing at 3.5'
					End of Boring at 10.5' bgs	
15						Impacts: 0.0: none 1.0': faint sheen and faint weathered odor 2.5': no sheen, anoxic odor 5.0': none 7:0': no indication
20.0						